OPTICAL ELECTRONICS INCORPORATED
BOX 11140, TUCSON, ARIZONA 85706

Your Optical
Electronic
Future

TUCSON ARIZ. FEB 7 '72 0.00

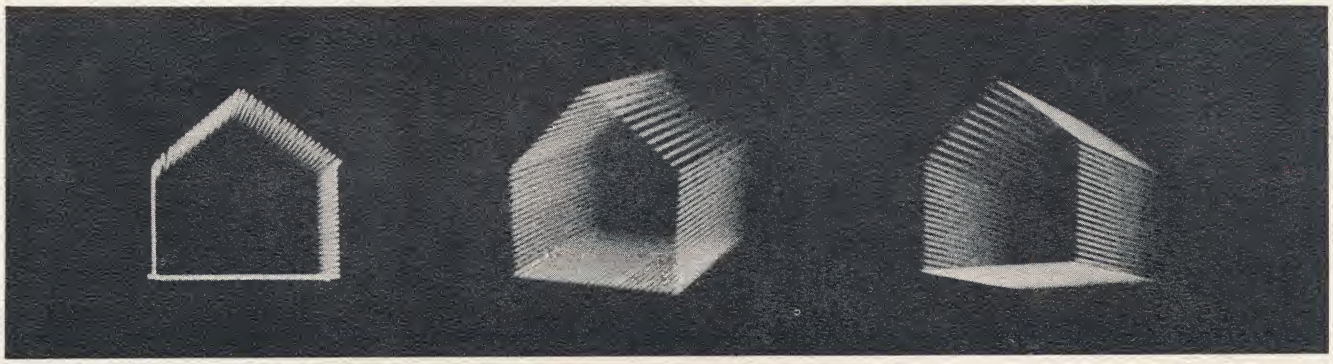
T. Nelson

Box 3

Schooleys Mountain, New Jersey 07870

3-D DISPLAY
BUILDING BLOCK MODULES

★ ~~JAN 72~~
FEB 72



3 views of the same image showing aerial and geometric perspective, interposition and parallax.

The 6100 SERIES from OEI.....

A complete set of modules to make up a variety of three-dimensional display systems. There are four basic types of modules that provide amplification of each deflection input, magnification of the entire image, continuous rotation about each axis and depth of focal field. Many combinations of modules is possible resulting in displays ranging from fixed position with perspective to three degrees of rotational freedom with magnification and depth of focus plus geometric and aerial perspective, interposition and monocular or binocular (stereo) options.

The modules provide an analog generated image having three orthogonal deflection axes. A monocular image is a single image having the three deflection axes and both perspective depth cues plus interposition, movement parallax (rotation) and depth of focus depth cues. An ambient light filter in front of the display removes a flatness cue making a total of six depth cues. This provides a rather strong depth conviction. Binocular (stereo) display adds a seventh depth cue which is not necessary for most applications.

The entire image may be programmed by DC analog voltages, from magnification to position and focus. Since the system is analog, it directly couples to analog computers and other systems. Via digital to analog converters, it is used with digital hardware.

A description of how the three-dimensional display is put together and how it works is shown on the next two pages.

CHANNEL AMPLIFIER - This module is the basic building block. Three are required to make any system configuration. The simplest system has just three amplifiers plus resistors to place the image in a fixed position. The channel amplifier provides a single ended high impedance input for use with an input attenuator. Variable gain is provided plus the geometric and aerial perspectives. Three models are provided, each with different bandwidth capability. The three models are physically identical and are all compatible with all other modules that make up the display system. In many instrument displays when the same information is always presented, the three channel amplifiers are all that is required.

ROTATOR - The rotator module is used to continuously rotate the 3-D image about one axis. If two degrees of rotational freedom are required, two rotators are used. If three degrees are needed, three rotator modules must be used. The rotator module converts a DC input voltage into a physical angular position, hence an analog programmer may be used to automatically position the image. Also, with viewer position information, the image may be made stationary in space with respect to the observer, allowing him to view all sides of the 3-D image without manual control. The rotator module also provides reference voltages used in the system. One model is compatible with all other system modules, regardless of bandwidth.

MAGNIFIER - The ability to enlarge or diminish a 3-D image is provided for by the magnifier module. Normally used at the smallest size level, if a portion or all of the image is of interest, it may be enlarged by a DC voltage. An analog programmer may be used to automatically establish image size. Three physically identical models of the magnifier for three system bandwidth requirements are available. They are all compatible with all other modules in the system. One magnifier module provides image enlargement along all three axes as though the distance between the observer and image were decreasing.

FOCAL FIELD - Without involving the high voltage or magnetic focus fields, image defocusing is accomplished with the focal field module. Vertical and Horizontal defocusing in front of and behind the focal plane adds important depth cue. The depth of focus and position of the focal place are both controlled parameters. The focal plane position is governed by a DC voltage, hence an analog programmer can automatically "focus the attention" of the observer on some plane of the image. One model is used for all bandwidths and for the whole display system.

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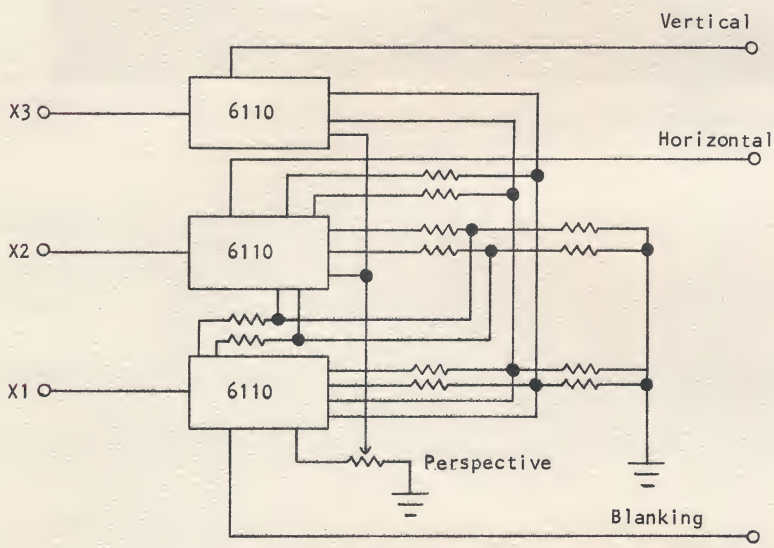
Over 30 different configurations of modules are possible with a three module minimum and an eight module maximum. All configurations offer different three-dimensional image controllability and depth cue content.

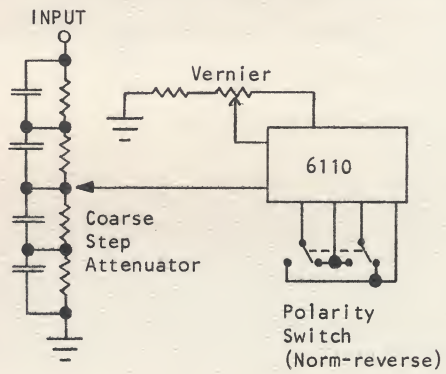
The basic system is shown below which is a minimum performance design. Resistors are shown to position the longitudinal axis at an angle where it can be seen (it would be in line with the observer if no resistors were used at all - hence it would not be visible at all). Note that the amount of geometric perspective is adjustable to suit the observer.

The basic system is suitable for built-in instrumentation uses where the same type of information will be presented. A switched resistor network can be used to shift the image orientation in discrete steps. All depth cues except focal field are available in this basic system. Consult OEI Applications Engineering for information concerning stereo displays.

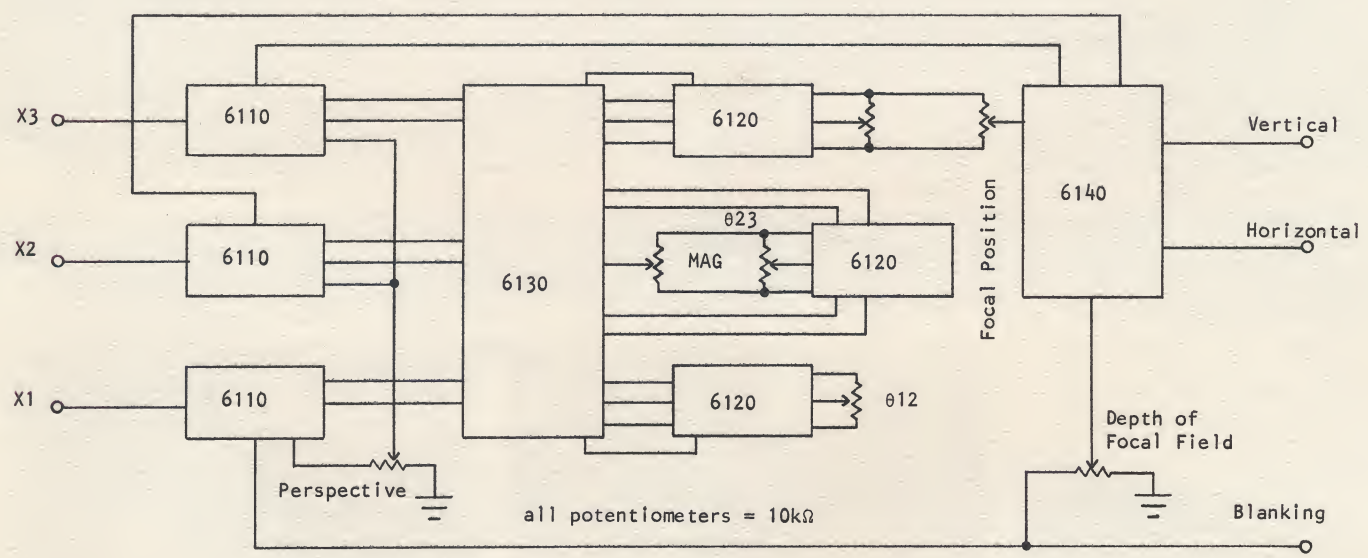
At the other extreme is the complete system consisting of eight modules. This provides all available depth cues (except stereo - consult OEI). The input attenuator, polarity reverse and size vernier adjustments are the same as in the simple system. Perspective adjustment is also the same. What is different is the magnification, the three rotational adjustments and the focal plane and depth of focus adjustments.



The basic display with X3 Vertically oriented, X2 horizontally oriented and X1 positioned frontward to the left of the viewer's sagittal axis. This circuit may be used with Models 6111 or 6112, depending on requirements.



Each channel amplifier may have a coarse attenuator and/or polarity reversal.

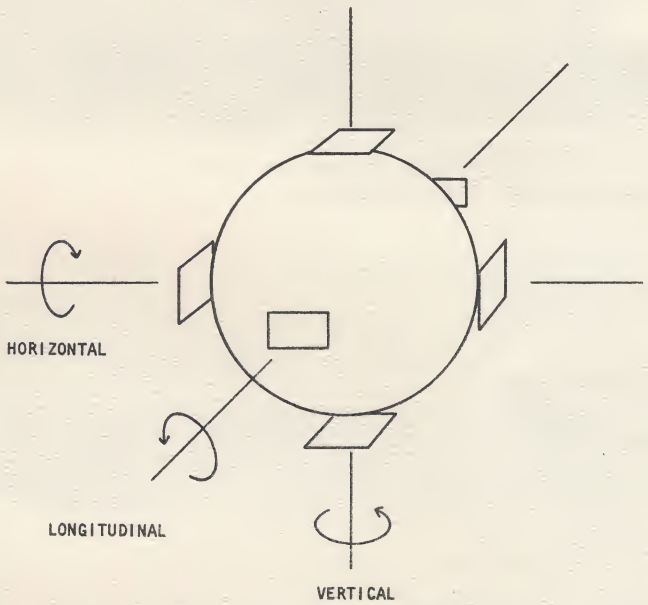


The complete 3-D modular system having continuous image rotation about all three axes, magnification, focal field plus aerial and geometric perspective and interposition depth cues. Channel amplifier input circuits may be as shown above.

The monocular 3-D image generated by this system can be explained by using a "crystal ball"! The principle of deflection of a CRT is generally well understood. In an oscilloscope there are two sets of deflection plates perpendicular to each other. Vertical and Horizontal deflection signals are applied to the two sets to obtain a two dimensional oscilloscope display.

The 3-D Graphic Display system modules produce vertical and horizontal deflection signals in addition to an intensity signal. These signals are obtained from three deflection input signals. Analog processing is used to simulate a spherical CRT having three sets of deflection plates all perpendicular to each other. As illustrated, the monocular 3-D display occupies a space inside a "crystal ball". The intensity signal merely tends to blank the beam corresponding to parts of the image obscured by portions in front and to diminish the beam for portions of the image far away from the observer.

As illustrated, the display has the usual horizontal and vertical deflection plates for up-down and left-right deflection as well as a set of Longitudinal plates for forward-backward deflection. This established a display or viewing *Space* instead of area.

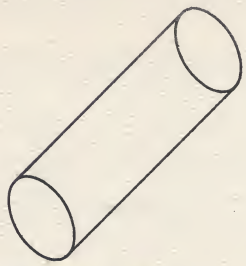


The modules produce geometric and aerial perspectives. which are illustrated. The amount of perspective is adjustable from zero to twice normal for individual viewer requirements. The two types of perspectives are usually sufficient to eliminate much ambiguity but this will not satisfy all images. The basic modules (Channel amplifiers) will not only produce perspective but they generate the interposition depth cue. Interposition is that fact that an object or portion of an object will obscure all that is behind it.

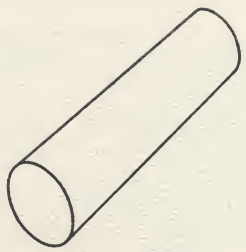
More involved systems provide movement parallax with the use of rotator modules. This is the relative difference in position of various portions of the image as the point of view is changed. When all three rotators are used, an infinite set of viewpoints are available in any octant.

Depth of Focus is a depth cue supplied by the focal field module. The module defocuses the image in accordance with the sagittal axis position (distance from the viewer). The depth of focus (size of area in focus) and focal plane position are two adjustable parameters associated with this depth cue and provided by the one module.

Five depth cues; aerial perspective, geometric perspective, interposition, movement parallax and focal field are provided by the basic module system. When the observer views this image on the flat CRT face, an anti-depth cue is created. Hiding the CRT with polarized filters (so that ambient light does not illuminate the CRT and only the trace is visible will remove an anti-depth cue or, effectively, add a sixth depth cue.



UNIDENTIFIABLE IMAGE because of ambiguities.



Non ambiguous image.

Stereo or binocular images are generally not necessary and not desired, but the modular system will easily provide this seventh depth cue. The binocular image contains all of the depth cues previously discussed, and requires minimum external circuitry - consult OEI Applicaitons Engineering for details.

The modular system may be used at DC with an XY recorder to create a 3-D plotter. The system will drive many XY oscilloscope displays.

Recording or storage of the information can be done on film or after the modular system however you *lose the ability to manipulate* the image and many depth cues. If the original data were recorded on a three track medium, then the data can be repeatedly replayed under different sets of circumstances (viewpoints, perspective level, size, etc.).

The magnifier module in the system does not offer a depth cue but generates a convenience and visual effect useful in many applications.

SYSTEM and MODULAR SPECIFICATIONS

OVERALL SYSTEM PARAMETERS[1]

CHANNEL AMPLIFIER - MODEL→	6110	6111	6112
OPTIONAL MODULES - MODEL→	6120	6120	6120
	6130	6131	6132
	6140	6140	6140
FULL SCALE INPUT VOLTAGE	±10V	±10V	±10V
INPUT IMPEDANCE	100MΩ	100MΩ	100MΩ
LARGE SIGNAL BANDWIDTH	DC - 5kHz	DC - 50kHz	DC - 500kHz
RISE TIME	70µS	7µS	700nS
DIFFERENTIAL PHASE SHIFT	<1°, DC - 5kHz	<1°, DC - 50kHz	<1°, DC - 500 kHz
OUTPUT LEVEL	±10V	±10V	±10V
MINIMUM LOAD RESISTANCE	1kΩ	1kΩ	1kΩ
OUTPUT SLEW RATE	±0.3V/µS	±5V/µS	±100V/µS
ROTATION MODULE - MODEL→	6120	6120	6120
MAGNIFIER MODULE - MODEL→	6130	6131	6132
FOCAL FIELD MODULE - MODEL→	6140	6140	6140
OPERATING TEMPERATURE RANGE	-55 to +100°C	-55 to +100°C	-55 to +100°C
MINIMUM POWER SUPPLY VOLTAGE	±12V	±12V	±12V
NOMINAL POWER SUPPLY VOLTAGE	±15V	±15V	±15V
MAXIMUM POWER SUPPLY VOLTAGE	±18V	±18V	±18V

INDIVIDUAL MODULE PARAMETERS[2]

CHANNEL AMPLIFIER SUPPLY CURRENT	±15mA	±24mA	±35mA
ROTATOR SUPPLY CURRENT	±60mA	±60mA	±60mA
MAGNIFIER SUPPLY CURRENT	±26mA	±38mA	±56mA
FOCAL FIELD SUPPLY CURRENT	+35/-20mA	+35/-20mA	+35/-20mA
CHANNEL AMPLIFIER SIZE[3]	36	36	36
ROTATOR SIZE[3]	49	49	49
MAGNIFIER SIZE[3]	48	48	48
FOCAL FIELD SIZE[3]	38	38	38
CHANNEL AMPLIFIER WEIGHT	2.0 oz	2.0 oz	2.0 oz
ROTATOR WEIGHT	7.5 oz	7.5 oz	7.5 oz
MAGNIFIER WEIGHT	5.3 oz	5.3 oz	5.3 oz
FOCAL FIELD WEIGHT	4.0 oz	4.0 oz	4.0 oz
CHANNEL AMPLIFIER MTBF[4]	481,000 Hrs	481,000 Hrs	481,000 Hrs
ROTATOR MTBF[4]	126,000 Hrs	126,000 Hrs	126,000 Hrs
MAGNIFIER MTBF[4]	113,000 Hrs	113,000 Hrs	113,000 Hrs
FOCAL FIELD MTBF[4]	228,000 Hrs	228,000 Hrs	228,000 Hrs

NOTES:

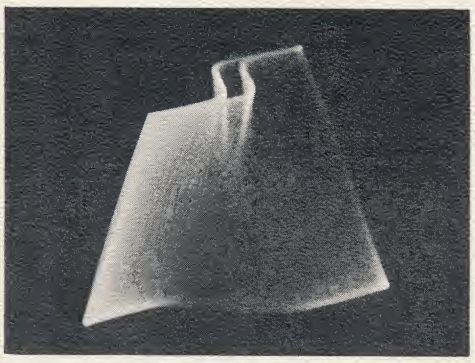
1 - Overall system consists of three channel amplifiers, three rotators, one magnifier and one focal field module for greatest capability. The minimum system has three channel amplifiers only.

2 - The information given pertains to each module. For example, the supply current must be multiplied three times for the channel amplifier, etc.

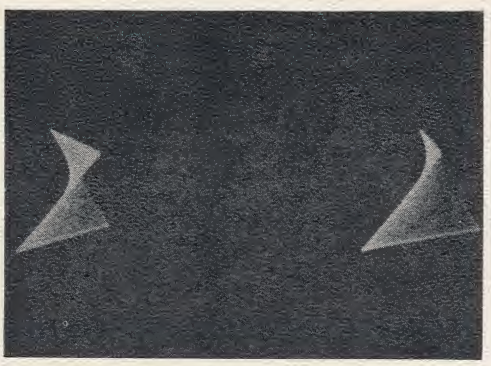
3 - Size 36 measures 2.5 inches by 1.5 inch by 0.5 inch. Size 38 is 3.25 inches by 1.5 inch by 0.625 inch high. Size 48 measures 3.125 inches by 2.625 inches by 0.625 inch high. Size 49 is 4.05 inches by 3.3 inches by 0.55 inch high.

4 - MTBF is calculated in accordance with MIL-HDBK-217A.

EXAMPLE: Consider a full system for DC - 50kHz with all modules. The total power supply current is +325 milliamps, -310 milliamps. The modules would weigh 37.8 ounces. The MTBF for the system modules would be 23,000 hours. The system would consist of 3 - Model 6111, 3 - Model 6120, 1 - Model 6131 and 1 - Model 6140 modules.



A 4-Quadrant Analog Multiplier showing phase shift.



A Stereo pair of a 4-Quadrant Analog Multiplier Transfer Function.

Model 6140

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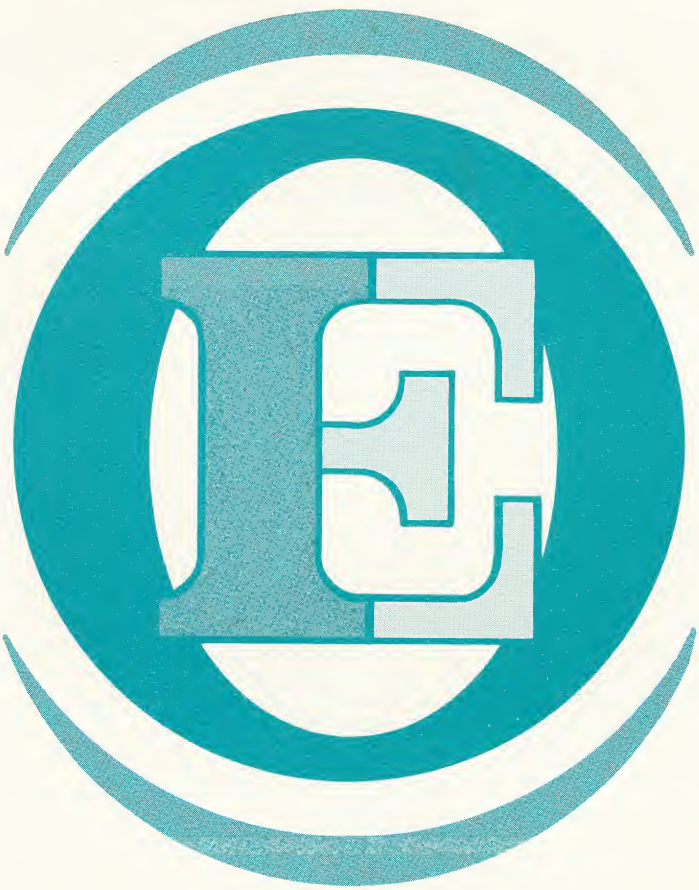

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An illustration of capability . . .

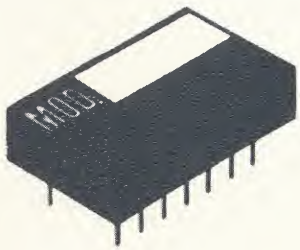
OPERATIONAL AMPLIFIERS

FASTEST SLEW RATE - 1800V/μS - MODEL 9808
WIDEST CLOSED-LOOP BANDWIDTH - 300MHz - MODEL 9491A
LARGEST GAIN - BANDWIDTH PRODUCT - 1000MHz - MODEL 9491A
FASTEST SETTLING TIME - 12nS to 0.1% - MODEL 9491A
LOWEST OFFSET VOLTAGE DRIFT - 0.6μV/°C - MODEL 9811
HIGHEST VOLTAGE SWING - ±75V - MODEL 9699
LOWEST COST - $29 - ±300V/μS - MODEL 9406

CURRENT BOOSTERS/FOLLOWERS

FASTEST SLEW RATE - 2000V/μS - MODEL 9510
WIDEST BANDWIDTH - 100MHz - MODEL 9510
HIGEST OUTPUT CURRENT - ±10 AMPS - MODEL 9691A
HIGEST VOLTAGE SWING ±75 VOLTS - MODEL 9800
LOWEST INPUT BIAS CURRENT - 10fA - MODEL 9708
HIGHEST PRECISION ±.01% - MODEL 9714

LOGARITHMIC AMPLIFIERS



ALL BIPOLAR - ALL DC COUPLED
MOST ACCURATE - 40dB - 0.1% - MODEL 2538
MOST ACCURATE - 60dB - 0.3% - MODEL 2245C
MOST ACCURATE - 80dB - 0.6% - MODEL 2534
PROGRAMMABLE - MODEL 2538
WIDEST DYNAMIC RANGE - 200dB - MODEL 2536
UNIVERSAL BIPOLAR ARRAY - MODEL 2457
UNIVERSAL UNIPOLAR ARRAY - MODEL 2534
HYBRID FEEDBACK ELEMENT - MODEL 2523
CONSTANT WIDE BANDWIDTH - 10MHz - MODEL 2540

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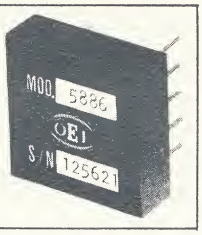
TRIGONOMETRIC FUNCTIONS

VECTOR CALCULATOR - MODEL 5712A ● COORDINATE CONVERTER - MODEL 5762A
● SINE/COSINE GENERATOR - MODEL 5762A ●

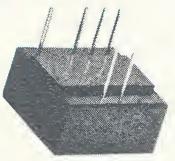
ANALOG MEMORIES

FASTEST SAMPLE & HOLD - 3nS - MODEL 5734A
FASTEST PEAK SENSE & HOLD - 30nS - MODEL 5893
MOST ACCURATE SAMPLE & HOLD - 0.1% - MODEL 5886
MOST ACCURATE PEAK SENSE & HOLD - 0.01% - MODEL 5641
INFINITE MEMORY SAMPLE & HOLD - MODEL 5894



VOLTAGE/FREQUENCY CONVERTERS

COMPLEMENTARY V➛F/F➛V - MODELS
0.100kHz UNIVERSAL - MODELS 3329/3337
0.03% F➛V - MODELS 3327, etc.
0.1% V➛F - MODEL 3370



ANALOG MULTIPLIERS/DIVIDERS

WIDEST BANDWIDTH - 30MHz - MODEL 5822B
GREATEST ACCURACY - ±1% TOTAL - MODEL 5887
MULTIPLIER/DIVIDER - 1MHz,±2% - MODEL 5897
WIDEST DYNAMIC RANGE - 60dB - MODEL 5895

NON-LINEAR FUNCTIONS

LINEAR AGC AMPLIFIER - 10MHz - MODEL 5888
RMS CONVERTER - 1MHz - MODEL 5889
VARIABLE BIPOLAR REFERENCE - ±10V - MODEL 8900
ANALOG GATES - MODELS 9002/9003
ABSOLUTE VALUE - MODEL 9004
0.1% AMPLITUDE LIMITER - MODEL 9005

3-D DISPLAY MODULES

3-D DISPLAY - MODEL 6100 series
INTERPOSITION & PERSPECTIVE CUES - MODEL 6110
ROTATION - MODEL 6120
MAGNIFICATION - MODEL 6130
FOCAL FIELD - MODEL 6140
ALPHANUMERIC/GRAPHIC MULTIPLEXER - MODEL 6150
TRIPLE ORTHOGONAL AXIS GENERATOR - MODEL 6160
BAR GRAPH GENERATOR - MODEL 6300
PINCUSHION/FOCUS CORRECTION - MODEL 5890

Ask for the complete product catalog from OEI....Specify modules and/or displays. Complete product information and specific application assistance is yours for the asking. OEI will be happy to help.

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OEI Optical Electronics Inc.

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DOMESTIC REPRESENTATIVES

ALABAMA	OEI	602-624-8358
ALASKA	OEI	602-624-8358
ARIZONA	JF HURLBUT	303-279-7138
ARKANSAS	APPLIED SCIENCE ACCTS	214-352-4829
CALIF/NORTHERN	IFM NORTH	415-961-2828
CALIF/SOUTHERN	CDH ASSOC	213-345-3111
COLORADO	JF HURLBUT	303-279-7138
CONNECTICUT	OEI	602-624-8358
DELAWARE	JOHN HOPKINS ASSOC	703-280-2086
FLORIDA	WMM ASSOC	813-446-0075
FLORIDA	WMM ASSOC	305-943-3091
FLORIDA	WMM ASSOC	305-831-4645
FLORIDA	WMM ASSOC	305-848-9042
GEORGIA	OEI	602-624-8358
HAWAII	ALOHA ASSOC	808-922-3819
IDAHO/SO EASTERN	JF HURLBUT	801-299-4321
ILLINOIS/NORTHERN	COOMBS ASSOC	312-298-4830
ILLINOIS/SOUTHERN	COOMBS ASSOC	314-542-3657
INDIANA	COOMBS ASSOC	312-298-4830
IOWA	COOMBS ASSOC	312-298-4830
KANSAS	COOMBS ASSOC	314-542-3657
KENTUCKY	S STERLING	513-298-7573
LOUISANA/NORTHERN	APPLIED SCIENCE ACCTS	214-352-4829
LOUISANA/SOUTHERN	OEI	602-624-8358
MAINE	OEI	602-624-8358
MARYLAND	JOHN HOPKINS ASSOC	703-280-2086
MASSACHUSETTS	OEI	602-624-8358
MICHIGAN	S STERLING	313-255-1970
MINNESOTA	COOMBS ASSOC	312-298-4830
MISSISSIPPI	OEI	602-624-8358
MISSOURI	COOMBS ASSOC	314-542-3657
MONTANA	JF HURLBUT	303-279-7138
NEBRASKA	COOMBS ASSOC	314-542-3657
NEVADA	OEI	602-624-8358
NEW HAMPSHIRE	OEI	602-624-8358
NEW JERSEY/NORTHERN	J J S ASSOC	201-233-4562
NEW JERSEY/SOUTHERN	BACH-STEWART ASSOC	215-927-1200
NEW MEXICO	JF HURLBUT	303-279-7138
NEW YORK/UP STATE	RJC ASSOC	607-753-3909
NEW YORK CITY	J J S ASSOC	201-233-4562
NORTH CAROLINA	OEI	602-624-8358
NORTH DAKOTA	OEI	602-624-8358
OHIO/NORTHERN	S STERLING	216-442-8080
OHIO/SOUTHERN	S STERLING	513-298-7573
OKLAHOMA	APPLIED SCIENCE ACCTS	214-352-4829
OREGON	OEI	602-624-8358
PENNSYLVANIA/EASTERN	BACH-STEWART	215-927-1200
PENNSYLVANIA/WESTERN	S STERLING	412-922-5720
RHODE ISLAND	OEI	602-624-8358
SOUTH CAROLINA	OEI	602-624-8358
SOUTH DAKOTA	OEI	602-624-8358
TENNESSEE	OEI	602-624-8358
TEXAS/NORTHERN	APPLIED SCIENCE ACCTS	214-352-4829
TEXAS/SOUTHERN	APPLIED SCIENCE ACCTS	713-467-3556
UTAH	JF HURLBUT	801-299-4321
VERMONT	OEI	602-624-8358
VIRGINIA	JOHN HOPKINS ASSOC	703-280-2086
WASHINGTON	OEI	602-624-8358
WASHINGTON D.C.	JOHN HOPKINS ASSOC	703-280-2086
WYOMING	JF HURLBUT	303-279-7138
CANADA	ELECTRODESIGN LTD	514-363-5120
CANADA	ELECTRODESIGN LTD	416-787-0991
CANADA	ELECTRODESIGN LTD	613-745-0541

AMPLIFIERS

- operational
- logarithmic

FUNCTION MODULES

- multipliers
- dividers
- squarers
- square-rooters
- peak sense & hold
- sample sense & hold
- voltage-frequency
- frequency-voltage

THREE DIMENSIONAL DISPLAYS

FOREIGN REPRESENTATIVES

AUSTRALIA	A J FERGUSON PTY LTD	51-6895
AUSTRALIA	FERGUSON AGENCIES PTY LTD	43-9451
AUSTRALIA	ELECTROBIT COMPANY	67-4611
DENMARK	DANSEL AS	03/15 16 04
FRANCE	SOCIETE ELECTRONIQUE	ROQ.82-95et91-64
GERMANY	KRAUS ELEKTRONIK KG	(06 11) 54 50 46
HOLLAND	MULDER-HARDENBERG AMSTERDAM Z	(020) 76 10 20
ITALY	COMPAGNIA DI REGOLAZIONI AUTOMATICHE S.R.L.	.688.1578
JAPAN	MARUBUN CO., LTD	(03)622-8151
SWEDEN	AMERIKANSKA TELEPRODUKTER AB	7109950.7109960
SWITZERLAND	ELEKTRONIK UND MESSTECHNIK	150-483-007/480244

Feb 72

OEI SUPPLEMENTARY PRICE LIST

January 3, 1972

MODEL	PRICE 1-2	PRICE 3-9	PRICE 10-29
2533	$250	$225	$203
2534	185	165	149
2538	100	92	83
2540	333	300	270
396	100	90	81
3327	150	135	122
3328	150	135	122
3330	150	135	122
3331	150	135	122
3332	150	135	122
3333	150	135	122
3704	87	78	71
3705	189	170	153
3706	295	265	239
5000	61	55	50
5822B	87	79	72
5886	89	80	72
5887	106	95	87
5888	321	305	290
5889	228	205	185
5890	328	295	266
5891	167	150	136
5892	216	194	175
5893	87	78	71
5894	289	260	234
5895	150	135	122
5897	122	110	99
5904	103	92	83
11026	2.50	2.50	2.50
11027	2.75	2.75	2.75

PRICE CHANGES

5712A	$233	$210	$189
5762A	310	278	251
9491A	60	54	49

MODEL	PRICE 1-2	PRICE 3-9	PRICE 10-29
6110	$130	$115	$104
6111	230	205	185
6112	335	300	270
6120	455	410	369
6130	320	285	257
6131	465	420	378
6132	615	555	500
6140	280	250	225
6300	262	235	224
9000	49	44	40
9001	40	36	33
9002	53	48	44
9003	53	48	44
9004	40	36	33
9005	65	59	54
9006	32	29	27
9007	85	77	70
9008	58	52	47
9009	43	39	35
9050	69	63	56
9714	90	81	73
9715	90	81	73
9716	80	72	65
9718	92	88	84
9720	30	27	25
9721	66	60	54
9723	37	33	29
9724	102	92	83
9725	62	56	51
9726	62	56	51
9727	32	29	26
9729	92	83	75
9746	36	32	29
9803	140	133	127
9804	49	44	40
9805	90	81	73
9807	55	50	45
9808	150	135	122
9810	41	37	34
9811	94	84	75
9813	38	35	32
9815	68	62	56
9816	60	54	49
9817	98	89	81
9818	98	89	81

Terms and Conditions as noted on page 22 of Catalog 70-71 Apply.

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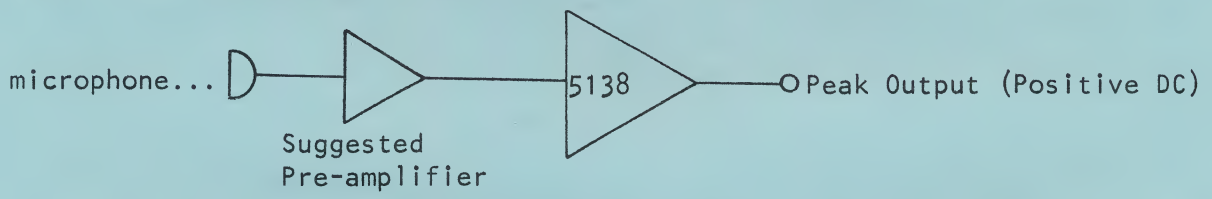
APPLICATION TIP 10150

THREE APPLICATIONS FOR PEAK SENSE AND HOLD MODULES

OEI Models 5138 and 5146 are analog memories stimulated by a peak input amplitude. Memory is ended either by resetting the module with an external voltage pulse or by reaching a new, higher peak amplitude at the input, or by allowing the module to "forget" due to decay of the internal memory capacitor charge.

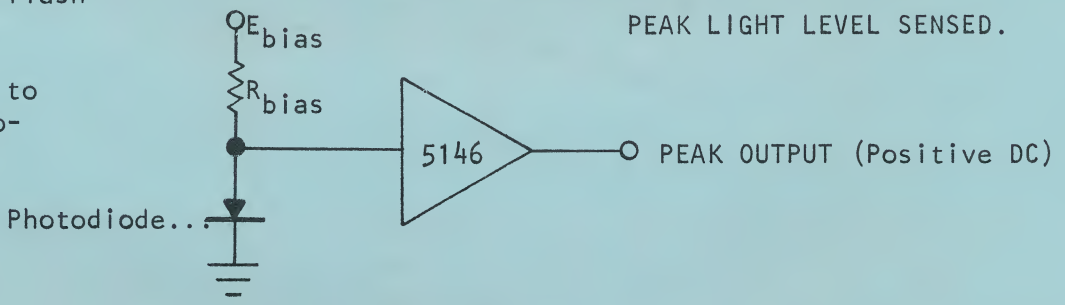
Because the module stores the peak input value, it is useful in transient analysis. Transient voltages are directly applicable to the modules , but, in addition, other forms of energy may be measured through the use of the proper transducer. The first example below uses a microphone as a transducer from mechanical energy to electrical energy. A preamplifier is recommended to raise the microphone level to 10 Volts Full Scale. The pre-amplifier may be logarithmic, producing an output indicating peak decibels, with the proper scaling...peak dbm. The peak noise could be that of an explosion, the roar of a rocket, the noise of a siren, machinery, music, etc.

ACOUSTIC PEAK LEVEL SENSED:



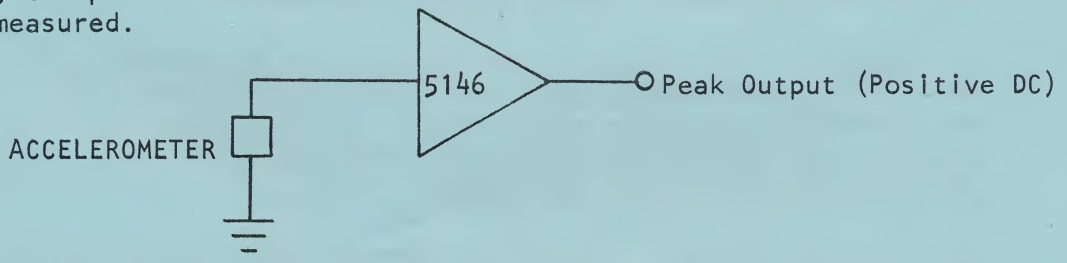
The peak level of light energy is quite important when analyzing light bulbs at burn-out, cathode ray phosphors at burn, the flash of a flash-bulb, the flash of lightning, the flash of an explosion.

PEAK LIGHT LEVEL SENSED.



It may be desired to increase the photodiode output with a pre-amp, either linear or logarithmic.

The maximum acceleration of an object indicates maximum thrust, shock, vibration, etc., depending upon various physical factors. Using an accelerometer or acceleration transducer, the peak acceleration is measured.



The 5138 and 5146 modules sense the positive input peaks only. Generally, this is not a problem but, if it is, an absolute value circuit placed at the input will generate an absolute peak output, irregardless of polarity.

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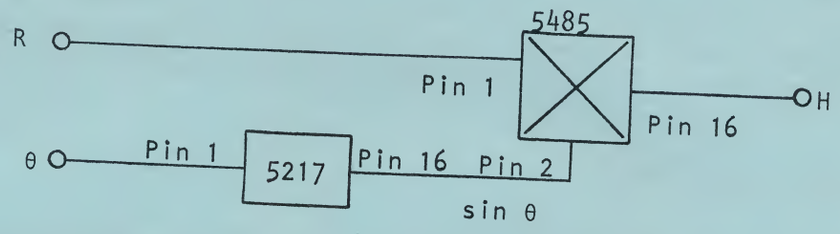
A VERTICAL HEIGHT TRIGONOMETRIC COMPUTER

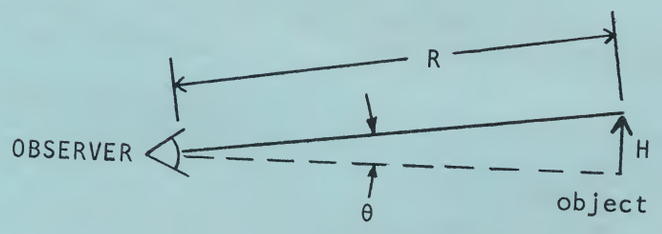
APPLICATION TIP 10151

An analog multiplier and a sine function module are the basic ingredients for computing the height of an object knowing its range (to the top) and its angle of elevation (to the top). This is illustrated in the sketch below.

The range information may be obtained from a range-finding radar system and it may be periodic (range-ramp) or steady state. The elevation information comes from the radar antenna system or scanning system or optical system, etc. The inportant factors to consider are the limits of ±10 Volts amplitude on both the range, R, and the elevation angle, θ. The elevation voltage in converted into



$$H = R \sin \theta$$



a sinusoidal form with an OEI Model 5217 Sine Function Module. The sin θ information drives the input of a four-quadrant analog multiplier, OEI Model 5485. The other multiplier input is driven by R, hence the output of the 5485 is the solution of range multiplied by the sine of the elevation angle.

The elevation angle need not be positive, that is, over the horizon. The Depth of an object (hole, canyon, pit, etc.) can be found knowing the range to the far bottom corner and the angle of depression.

The function of the above is the same as the mechanical servo resolver system. This method used motors, gear trains and potentiometers, was slow and bulky. The solid state approach above offers low cost (less than $140) with reasonable accuracy (±2% worst case) and vastly improved size factor, reliability, power consumption and speed of operation.

Applications include fire control, navigational information and general computation of trigonometric problems.

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February 7, 1972

T. Nelson
Box 3
Schooleys Mountain, New Jersey 07870

Mr. Nelson:

Please find the enclosed information you requested on Optical Electronics, Inc. products. This information should be excellent help in your considerations of OEI products.

We suggest, if you need additional information, you contact our Representative in your area or our Application Engineering Department. The Application Engineers are here to serve your special requirements.

Sincerely,
OPTICAL ELECTRONICS, INC.

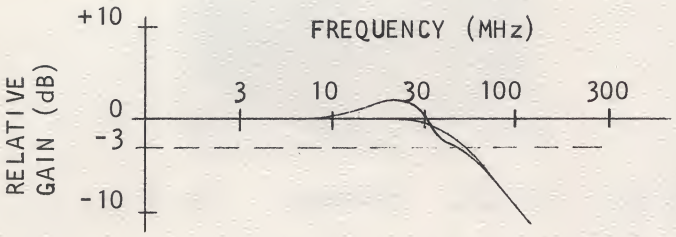
S.E. Gerdes

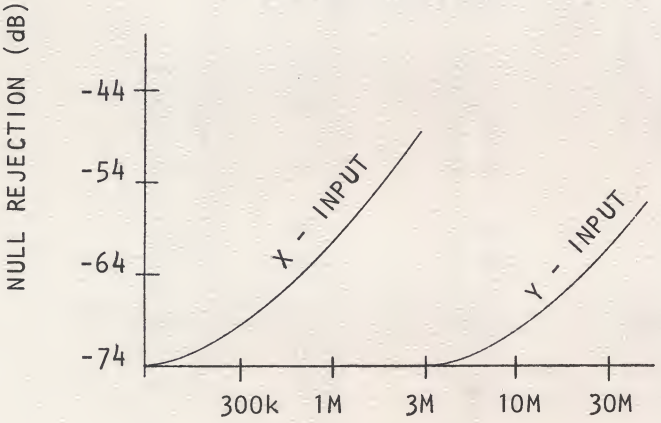
S.E. Gerdes
Sales Manager

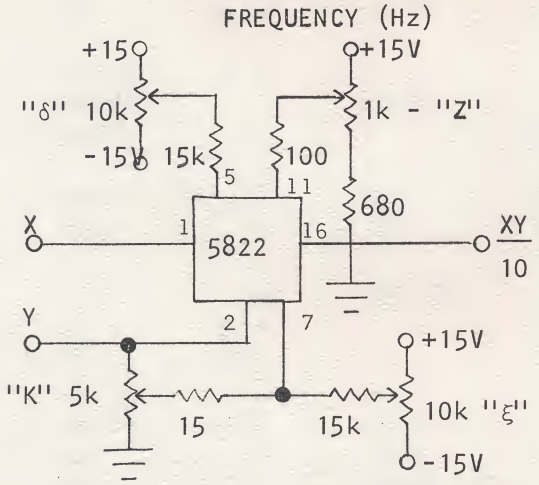
SEG/nm
Encl.
c.c. JJS Associates
P.O. Box 1205
Mountainside, New Jersey 07092
(201) 233-4562

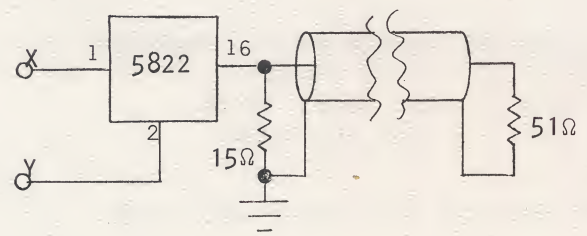
Feb 72

Applying the 5822









The 5822 is a four-quadrant analog multiplier having a DC to 30MHz bandwidth as shown at the left. This makes the 5822 useful in many applications including fast analog computation, display generators, fast correlators, phase demodulators, amplitude and balanced modulators.

The small signal bandwidth is greater than 30MHz as shown at the left. The roll off rate is 6dB/octave providing excellent transient response and low phase shift. Typical 3MHz overall phase shift is 10° and, for correlation, the differential phase shift can be externally cancelled.

The zero product loss, or null rejection, is shown at the left. Due to internal stray capacitive coupling, the null rejection begins to deteriorate at some high frequency. This is an important figure for balanced modulator and AGC amplifier applications.

The basic circuit configuration of a four-quadrant multiplier is shown at the left. All four potentiometers are shown for complete accuracy adjustment.

Also shown is the 5822 driving a 50ohm line. The 5822 may also drive a virtual ground summing junction. Under low impedance loads, bandwidth - both small and large signal - will increase.

The 5822, like all wideband amplifiers, must be bypassed at its power supply pins and a common ground point must be used. All wiring must be short and direct. Application information is available on request.

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30MHz
ANALOG MULTIPLIER 5822

- DC - 30MHz BANDWIDTH
- 73dB NULL REJECTION
- <3% LINEARITY
- BALANCED MODULATOR
- CRT DISPLAYS
- HIGH SPEED CORRELATOR

SPECIFICATIONS at +25 C, ±15Vs	MINIMUM	TYPICAL	MAXIMUM	UNITS
TRANSFER FUNCTION[1]		$E_o = (X+\delta)(Y+\xi)/K + Z$		
VALUE OF K^2 - UNTRIMMED	5	10	12	——
VALUE OF Z^2 - UNTRIMMED		±1	±3	Volts
VALUE OF δ^2 - UNTRIMMED		±0.8		Volts
VALUE OF ξ^2 - UNTRIMMED		±0.8	±2	Volts
LINEARITY OF X^3		±0.6	±2	%F.S.
LINEARITY OF Y^3		±0.6	±2	%F.S.
INPUT IMPEDANCE X, Y	4000	4300		Ohms
FULL SCALE VOLTAGE X,Y			±10	Volts
MAXIMUM INPUT VOLTAGE X,Y			±25	Volts
INPUT BIAS CURRENT X		±2	±10	µA
INPUT BIAS CURRENT Y		-2.1	-2.5	mA
FULL SCALE OUTPUT			±10	Volts
DYNAMIC OUTPUT IMPEDANCE		1000		Ohms
LOAD RESISTANCE[4]	50			Ohms
SMALL SIGNAL BANDWIDTH	30	40		MHz
LARGE SIGNAL BANDWIDTH	10	15		MHz
OUTPUT TEMPERATURE COEFFICIENT		±0.08	±0.1	%/°C
OPERATING TEMPERATURE RANGE	-55		+65	°C
STORAGE TEMPERATURE RANGE	-55		+85	°C
POWER SUPPLY VOLTAGE	±10	±15	±20	Volts
POWER SUPPLY CURRENT		±35		mA
POWER DISSIPATION		1050		mW
SIZE		1.0 inch square by 0.5 inch high		
WEIGHT		0.6 Ounce		
SOCKET		OEI Model 11016		
MTBF-per MIL-HDBK-271A		501,000 Hours		

NOTES:
1. This is the general expression showing the offset and scale factors.
2. The offset and scale factors may be externally trimmed.
3. Figures obtained under "trimmed" conditions.
4. The 5822 is designed to drive a 50 ohm line at 1 volt peak-to-peak which gives best frequency response. It will perform as specified above with a 3000 ohm load.

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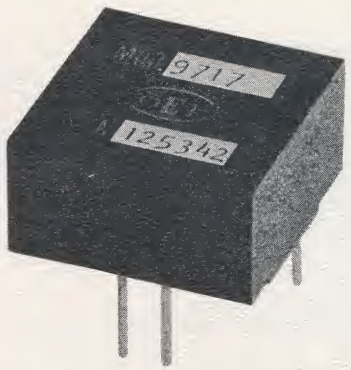
FET INPUT OPERATIONAL AMPLIFIERS

- PRECISION FOLLOWER - MODEL 9714
- LOW NOISE - MODEL 9720
- UNIVERSAL - MODEL 9716
- FAST 100V/µS - MODEL 9718
- WIDEBAND 20MHz - MODEL 9715



MODEL →	9714	9715	9716	9717	9718	9720
General Description	Precision[1] Follower	Low Drift[1] Wide Band	Universal[4] Fast-Low Power	General Purpose	Precision Fast	Preamps Video, Pulse
Minimum Open Loop Gain	1.0000	80dB	86dB	110dB	94dB	40dB
Minimum Input Resistance Differential	—	1.0TΩ	1.0TΩ	1.0TΩ	1.0TΩ	100GΩ
Minimum Input Resistance Common Mode	1.0TΩ	1.0TΩ	1.0TΩ	1.0TΩ	1.0TΩ	100GΩ
Maximum Input Capacitance Differential	—	2pF	2pF	2pF	2pF	3pF
Maximum Input Capacitance Common Mode	2pF	2pF	2pF	2pF	2pF	3pF
Common Mode Rejection at 1kHz	—	100dB	90dB	100dB	100dB	60dB
Common Mode Rejection at 1MHz	—	40dB	50dB	40dB	20dB	50dB
Maximum Noise[3] Voltage	300nV/√Hz	125nV/√Hz	200nV/√Hz	167nV/√Hz	300nV/√Hz	20nV/√Hz
Maximum Noise[3] Current	100fA/√Hz	100fA/√Hz	100fA/√Hz	100fA/√Hz	100fA/√Hz	500fA/√Hz
Maximum Input Voltage Differential	—	±30V	±30V	±30V	±30V	±15V
Maximum Input Voltage Common Mode	±11V	±11V	±12V	±10V	±10V	±11V
Maximum Input Offset Voltage[6]	±10mV	±10mV	±20mV	±10mV[5]	±10mV	±50mV
Maximum Offset Voltage Drift	±15µV/°C	±15µV/°C	±50µV/°C	±15µV/°C	±30µV/°C	±1mV/°C
Maximum Input Bias Current	±30pA	±30pA	±50pA	±50pA	±50pA	±10pA
Maximum Input Offset Current	—	±10pA	±15pA	±15pA	±15pA	±5pA
Maximum Offset Current Drift[2]	—	2X/10C°	2X/10C°	2X/10C°	2X/10/C°	2X/10C°
Power Supply Sensitivity	±200µV/V	±200µV/V	±1mV/V	±300µV/V	±300µV/V	±7mV/V
Output Voltage Swing	±10V	±10V	±10V	±10V	±10V	±10V
Into a load resistance of	250Ω	250Ω	100Ω	1kΩ	1kΩ	3.3kΩ
Open Loop Output Impedance	3mΩ	1Ω	50Ω	1kΩ	100Ω	1kΩ
Slewing Rate	±20V/µS	±20V/µS	100V/µS	±2V/µS	±100V/µS	±100V/µS
Maximum Full Output Frequency	300kHz	300kHz	1.5MHz	30kHz	1.5MHz	1.5MHz
Maximum Load Capacity	50pF	200pF	100pF	250pF	50pF	10nF
Gain - Bandwidth Product	20MHz	20MHz	15MHz	3MHz	50MHz	20MHz
Open Loop -3dB Frequency	—	2kHz	7kHz	10Hz	1kHz	200kHz
Maximum Closed Loop Bandwidth	20MHz	20MHz	10MHz	1.5MHz	10MHz	15MHz
Settling Time to 0.1% error	300nS	300nS	500nS	5µS	1µS	200nS
Operating Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Minimum	±5V	±5V	±4V	±5V	±7V	±6V
Power Supply (Rated) Nominal	±15V	±15V	±15V	±15V	±15V	±15V
Power Supply (Rated) Maximum	±18V	±18V	±22V	±22V	±18V	±20V
Power Supply Current (Quiescent)	±8mA	±8mA	±25mA	±2mA	±5mA	±22mA
Power Dissipation (Quiescent)	240mW	240mW	750mW	60mW	150mW	660mW
Case	52	52	53	50	52	53
Weight	0.8oz	0.8oz	0.6oz	1.2oz	0.8oz	0.6oz
Socket - Model	11026	11026	11026	11026	11026	11026
MTBF-per-MIL-HDBK-217A	798,000 Hrs	830,000 Hrs	698,000 Hrs	1,082,000 Hrs	1,076,000 Hrs	1,900,000 Hrs

NOTES: CASE DIMENSIONS:
50-1 → 1.125 inch square by 0.625 inch high
51-2 → 1.8 inch by 1.2 inch by 0.6 inch high
52-1 → 1.125 inch square by 0.5 inch high
53-1 → 1.125 inch square by 0.375 inch high

1. Model 9714 is a Model 9715 internally committed as a voltage follower with internal circuitry to prevent latch-up. Model 9715 will latch in a unity gain follower circuit.
2. Offset and Bias current doubles for every 10C° increase in temperature.
3. Noise spectral density is measured at 1kHz.
4. Model 9716 has three modes of operation. Specs shown are the highest performance levels attainable. In the micro power mode, dissipation is 750µW, open loop gain is 66dB. Slew rate is 15mV/µS, unity gain frequency is 1.5kHz, etc.
5. With external 2.0k, ±2% resistor connected between +V and the trim pin.
6. Offset voltage is externally adjustable to zero for all models on this page.

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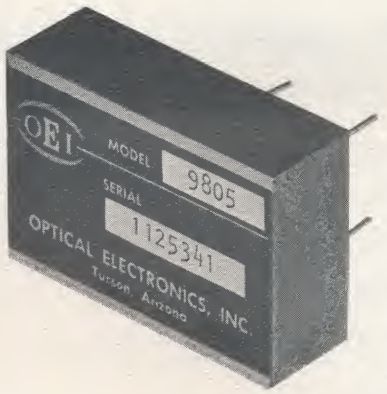
FET-BIPOLAR INPUTS

Operational Amplifiers



- FAST 750V/μS - MODEL 9805
- WIDEBAND - MODEL 9804
- LOW DRIFT - 1μV/°C - MODEL 9802
- LOW COST - MODEL 9723
- FAST SETTLING DIFFERENTIAL - MODEL 9804

MODEL →	9721	9723	9802	9803	9804	9805
General Description	General Purpose	Fast-General Purpose	Fast-Chopper Stabilized	Fast Stabilized	Wide Band High Power	Fast Inverting
Minimum Open Loop Gain	110dB	70dB	180dB	120dB	50dB	110dB
Minimum Input Resistance Differential	1.0TΩ	100GΩ	2MΩ	100MΩ	3kΩ	2MΩ
Minimum Input Resistance Common Mode	1.0TΩ	100GΩ	——	1GΩ	300kΩ	——
Minimum Input Capacitance Differential	2pF	3pF	3pF	5pF	3pF	6pF
Minimum Input Capacitance Common Mode	2pF	3pF	——	5pF	2pF	——
Common Mode Rejection at 1kHz	100dB	70dB	——	120dB	70dB	——
Common Mode Rejection at 1MHz	20dB	40dB	——	50dB	60dB	——
Maximum Noise[1] Voltage	167nV/√Hz	65nV/√Hz	300nV/√Hz	250nV/√Hz	50nV/√Hz	125nV/√Hz
Maximum Noise[1] Current	100fA/√Hz	500fA/√Hz	4pA/√Hz	1pA/√Hz	10pA/√Hz	1pA/√Hz
Maximum Input Voltage Differential	±30V	±15V	——	±10V	±5V	±10V
Maximum Input Voltage Common Mode	±10V	±11V	±25V	±10V	±10V	——
Maximum Input Offset Voltage[3]	±10mV	±20mV	±25μV	±5mV	±5mV	±1mV
Maximum Offset Voltage Drift	±30μV/°C	±50μV/°C	±1μV/°C	±2μV/°C	±100μV/°C	±10μV/°C
Maximum Input Bias Current	±50pA	±10pA	±50pA	±50nA	±20μA	±20nA
Maximum Input Offset Current	±15pA	±5pA	——	±5nA	±3μA	——
Maximum Offset Current Drift[2]	2X/10C°	2X/10C°	±1pA/°C	±5pA/°C	±30nA/°C	±0.5nA/°C
Power Supply Sensitivity	±300μV/V	±500μV/V	±3μV/V	±100μV/V	±2mV/V	±100μV/V
Output Voltage Swing	±10V	±10V	±10V	±10V	±10V	±10V
into a load resistance of	1000Ω	100Ω	1000Ω	50Ω	50Ω	50Ω
Open Loop Output Impedance	100Ω	100Ω	100Ω	10Ω	10Ω	30Ω
Slewing Rate	±10V/μS	±50V/μS	±100V/μS	±100V/μS	±250V/μS	±750V/μS
Maximum Full Output Frequency	150kHz	800kHz	1.5MHz	1.5MHz	4MHz	12MHz
Maximum Load Capacity	50pF	10nF	200pF	10nF	200pF	300pF
Gain - Bandwidth Product	10MHz	30MHz	15MHz	15MHz	500MHz	60MHz
Open Loop -3dB Frequency	30Hz	10kHz	0.1Hz	20Hz	1.5MHz	10Hz
Maximum Closed Loop Bandwidth	10MHz	15MHz	10MHz	8MHz	60MHz	60MHz
Settling Time to 0.1% error	1μS	200nS	200nS	2μS	60nS	50nS
Operating Temperature Range	-55 to +85°C	-55 to +85°C	-25 to +85°C	-55 to +85°C	-55 to +75°C	-55 to +85°C
Storage Temperature Range	-55 to +85°C	-55 to +125°C	-55 to +100°C	-55 to +85°C	-55 to +85°C	-55 to +100°C
Power Supply (Rated) Minimum	±7V	±6V	±14V	±9V	±7V	±4V
Power Supply (Rated) Nominal	±15V	±15V	±15V	±15V	±15V	±15V
Power Supply (Rated) Maximum	±18V	±20V	±18V	±18V	±18V	±20V
Power Supply Current (Quiescent)	±5mA	±15mA	±7mA	±22mA	±33mA	±35mA
Power Dissipation (Quiescent)	150mW	450mW	210mW	660mW	990mW	1050mW
Case	52	52	50	53	53	51
Weight	0.8oz	0.8oz	1.0oz	0.6oz	0.6oz	1.4oz
Socket - Model	11026	11026	11026	11026	11026	11027
MTBF-per-MIL-HDBK-21/A	1,076,000 Hrs	876,000 Hrs	374,000 Hrs	456,000 Hrs	435,000 Hrs	782,000 Hrs

NOTES:
1. Noise spectral density is measured at 1kHz.
2. Offset and Bias Current doubles for every 10C° increase for FET Models 9721 and 9723.
3. Offset voltage may be externally adjusted to zero for Models 9721, 9723,and 9802.

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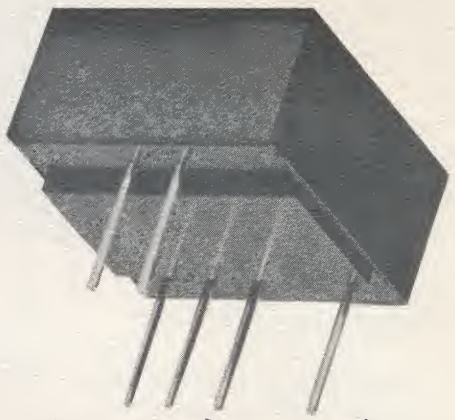
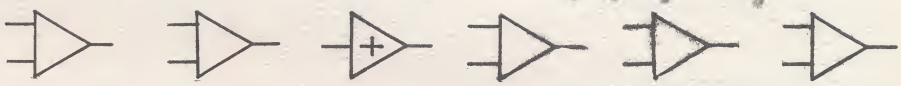
BIPOLAR INPUT
Operational Amplifiers



- FAST BOOSTER/FOLLOWER - MODEL 9810
- LOW DRIFT - 0.6µV/°C - MODEL 9811
- LOW NOISE - MODEL 9814
- PREMIUM POWER - MODEL 9811
- LOW COST - MODEL 9814



MODEL →		9807	9809	9810	9811	9813	9814
General Description		High Power	Power Stabilized	Follower Booster	Power Stabilized	General Purpose	General Purpose
Minimum Open Loop Gain		100dB	130dB	0.95	120dB	94dB	110dB
Minimum Input	Differential	3MΩ	100MΩ	—	100MΩ	3MΩ	2MΩ
Resistance	Common Mode	300MΩ	1GΩ	100kΩ	1GΩ	250MΩ	1GΩ
Minimum Input	Differential	4pF	5pF	—	5pF	4pF	5pF
Capacitance	Common Mode	5pF	5pF	10pF	5pF	5pF	6pF
Common Mode	at 1kHz	90dB	120dB	—	120dB	90dB	100dB
Rejection	at 1MHz	30dB	50dB	—	50dB	30dB	40dB
Maximum	Voltage	45nV/√Hz	125nV/√Hz	—	40nV/√Hz	45nV/√Hz	20nV/√Hz
Noise[1]	Current	1pA/√Hz	1pA/√Hz	—	1pA/√Hz	1pA/√Hz	1pA/√Hz
Maximum Input	Differential	±15V	±10V	—	±10V	±10V	±15V
Voltage	Common Mode	±10.5V	±10V	±12V	±10V	±10V	±10V
Maximum Input Offset Voltage[2]		±5mV	±1mV	±100mV	±5mV	±15mV	±500µV[3]
Maximum Offset Voltage Drift		±10µV/°C	±1µV/°C	±200µV/°C	±0.6µV/°C	±10µV/°C	±3µV/°C
Maximum Input Bias Current		±20nA	±50nA	±100µA	±50nA	±50nA	±40nA
Maximum Input Offset Current		±5nA	±5nA	—	±5nA	±20nA	±4nA
Maximum Offset Current Drift		±100pA/°C	±5pA/°C	—	±5pA/°C	±0.3nA/°C	±20pA/°C
Power Supply Sensitivity		±100µV/V	±100µV/V	—	±100µV/V	±100µV/V	±30µV/V
Output Voltage Swing		±10V	±10V	±10V	±10V	±10V	±10V
into a load resistance of		50Ω	50Ω	100Ω	50Ω	1200Ω	1kΩ
Open Loop Output Impedance		10Ω	10Ω	10Ω	10Ω	200Ω	100Ω
Slewing Rate		±2V/µS	±0.3V/µS	±900V/µS	±2V/µS	±2V/µS	±0.3V/µS
Maximum Full Output Frequency		30kHz	5kHz	15MHz	30kHz	30kHz	5kHz
Maximum Load Capacity		10nF	10nF	—	10nF	1nF	1nF
Gain Bandwidth Product		1MHz	1MHz	—	1MHz	1MHz	700kHz
Open Loop -3dB Frequency		10Hz	0.3Hz	—	1Hz	10Hz	3Hz
Maximum Closed Loop Bandwidth		1MHz	1MHz	40MHz	1MHz	1MHz	700kHz
Settling Time to 0.1% error		2µS	5µS	—	5µS	5µS	7µS
Operating Temperature Range		-55 to +75°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Storage Temperature Range		-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power	Minimum	±5V	±9V	±5V	±9V	±9V	±6V
Supply (Rated)	Nominal	±15V	±15V	±15V	±15V	±15V	±15V
Voltage	Maximum	±20V	±18V	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)		±5mA	±22mA	±10mA	±18mA	±3mA	±3mA
Power Dissipation (Quiescent)		150mW	660mW	300mW	540mW	90mW	90mW
Case		53	53	52	53	53	53
Weight		0.6oz	0.6oz	0.8oz	0.6oz	0.6oz	0.6oz
Socket - Model		11026	11026	11026	11026	11026	11026
MTBF-per-MIL-HDBK-217A		1,189,000 Hrs	456,000 Hrs	526,000 Hrs	456,000 Hrs	1,917,000 Hrs	1,900,000 Hrs

NOTES:
1. Noise spectral density is measured at 1kHz.
2. Input Offset Voltage is externally adjustable to zero with Models 9807, 9813 and 9814.
3. Input offset voltage when used with trim resistor supplied.

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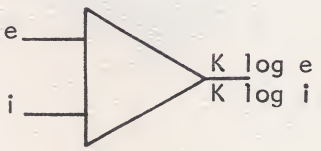
ANALOG FUNCTION MODULES

2538 – BIPOLAR LOGARITHMIC AMPLIFIER

SPECIFICATIONS at +25°C, ±15Vs

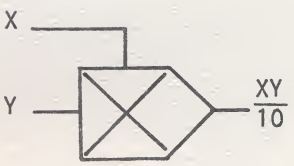
Dynamic Range:	80dB, ±1mV to ±10V, ±10nA to ±100µA
Error of Output:	±2% max., ±0.6% typical over 80dB, ±0.3% typical over 60dB
Output Dynamic Range:	±2.5V to ±6.5 corresponding to the input levels, inverted in polarity
Temperature Coefficient:	±0.03% FS/°C over -55 to +85°C
Frequency Response:	DC to 100kHz, 10µS settling time at full scale. DC to 1kHz, 500µS settling time at minimum input
Power Required:	±10V to ±18V, ±23mA at ±15V supplies
Physical:	Case 52, 0.8 ounce, uses OEI Model 11026 socket, 548,000 Hours MTBF.



5887 – ANALOG MULTIPLIER

SPECIFICATIONS at +25°C, ±15Vs

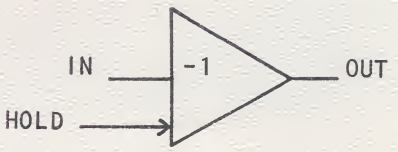
TRANSFER FUNCTION:	$E_o = XY/10$
Error:	±2% max. non-linearity. ±1% offset errors. ±2% scale factor error. ±1% typical overall error.
Inputs:	±10V full scale, 10M impedance
Output:	±10V full scale, ±10mA, 1.0 ohm impedance. Offset adjustable.
Frequency Response:	DC - 1MHz small signal, DC - 100kHz large signal
Temperature Coefficient:	±3mV/°C, -25°C to +85°C
Power Required:	±12V to ±18V, ±10mA at ±15V.
Physical:	Case 52, 0.8 ounce, uses OEI Model 11026 socket, 645,000 Hours MTBF.



5886 – SAMPLE AND HOLD

SPECIFICATIONS at +25°C, ±15Vs

Error:	±0.1% unity gain error, ±30mV hold command feed-through (offset), ±100mV/second memory decay rate, ±30mV input offset
Input	±10V full scale, 100k impedance
Command:	0 for sample/track, +10 volts for hold mode, 1 megohm impedance
Output:	±10V full scale at ±10mA, 10nF maximum capacitive load
Frequency Response:	DC to 10kHz signal bandwidth, 1µSec Aperture time, 20µS Acquisition time, 5µSec settling time to 0.1%.
Temperature Coefficient:	±300µV/°C at the output, -55°C to +85°C
Power Required:	±4 to ±20 volts, ±7 milliamps at ±15V
Physical:	Case 53, 0.6 ounce, uses OEI Model 11026 socket, 855,000 Hours, MTBF.



PDSCATS3 10M0271

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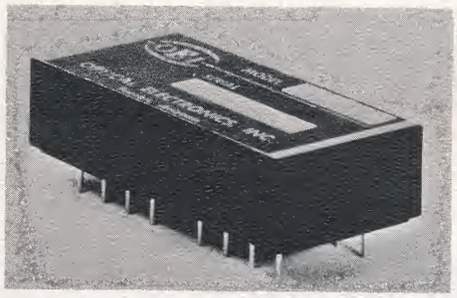
Feb 72

STATE-VARIABLE
ACTIVE FILTERS

- 0-500kHz FREQUENCIES
- INDEPENDENT ADJUSTMENT OF f, Q, Av
- MAY BE CASCADED
- ALL-PASS FILTERS
- QUADRATURE OSCILLATORS
- SIMULTANEOUS BANDPASS, LO-PASS AND HI-PASS OUTPUTS



Case 37

MODEL →	3704	3705	3706
GENERAL DESCRIPTION	General Purpose	Telemetry Systems	Communication Systems
FREQUENCY RANGE	0-5kHz	0-50kHz	0-500kHz
NOMINAL VOLTAGE GAIN	0dB	0dB	0dB
RANGE OF AVAILABLE "Q"	1-500	1-500	1-500
INPUT IMPEDANCE	100kΩ	30kΩ	10kΩ
MAXIMUM INPUT VOLTAGE	±10V	±10V	±10V
OUTPUT VOLTAGE SWING	±10V	±10V	±10V
INTO A LOAD OF	1kΩ	1kΩ	1kΩ
OUTPUT IMPEDANCE	1.0Ω	1.0Ω	1.0Ω
OUTPUT DC OFFSET VOLTAGE	±20mV	±20mV	±20mV
OUTPUT SLEWING RATE	±0.3V/μS	±4V/μS	±100V/μS
OP AMP GAIN-BANDWIDTH	500kHz	5MHz	15MHz
FILTER[1] LOW-PASS	12dB/oct	12dB/oct	12dB/oct
SKIRT BAND-PASS	6dB/oct	6dB/oct	6dB/oct
SELECTIVITY HIGH-PASS	12dB/oct	12dB/oct	12dB/oct
TUNING MINIMUM	1kΩ	1kΩ	1kΩ
RESISTANCE MAXIMUM	1MΩ	10MΩ	10MΩ
TUNING CAPACITANCE-MINIMUM	1nF	330pF	100pF
NOMINAL OF FREQUENCY	.01%/°C	.01%/°C	.01%/°C
TEMPERATURE OF "Q"	.01%/°C	.01%/°C	.01%/°C
COEFFICIENT OF GAIN	.01%/°C	.01%/°C	.01%/°C
OPERATING TEMPERATURE RANGE	-55 to +85°C	-55 to +85°C	-55 to +85°C
STORAGE TEMPERATURE RANGE	-55 to +85°C	-55 to +85°C	-55 to +85°C
POWER MINIMUM	±4V	±5V	±5V
SUPPLY RATED-NOMINAL	±15V	±15V	±15V
VOLTAGE MAXIMUM	±20V	±18V	±18V
QUIESCENT SUPPLY CURRENT	±8mA	±15mA	±24mA
QUIESCENT POWER DISSIPATION	240mW	450mW	720mW
CASE[2]	37	37	37
WEIGHT	1.2 oz	1.2 oz	1.2 oz
MTBF-per MIL-HDBK-217A	576,000 Hrs	514,000 Hrs	514,000 Hrs

NOTES: 1 - Bandpass Skirt Selectivity is in dB/bandwidth - octave
2 - Case 37 measures 2.0 inch by 1.0 inch by 0.5 inch high.

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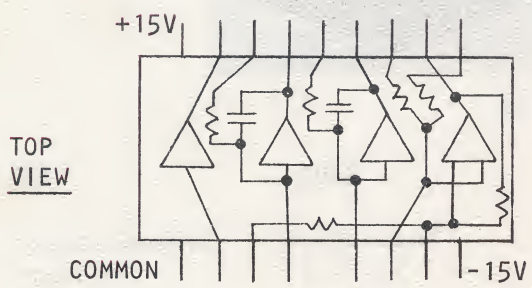
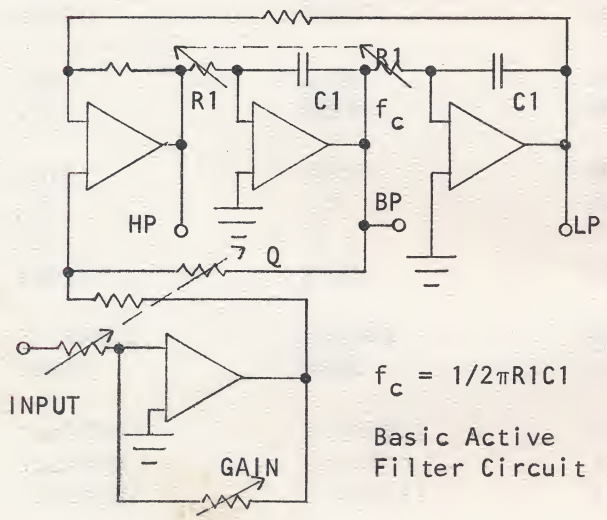
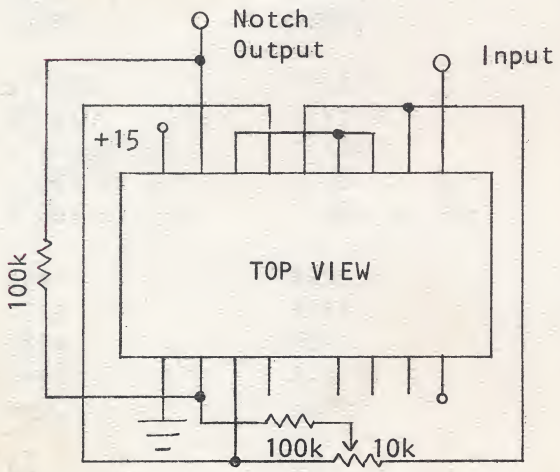




$f_c = 1/2\pi R1C1$

Basic Active Filter Circuit



The State Variable Active Filter is a versatile building block furnishing all filter functions: Lo-Pass, Hi-Pass, Band Pass, All-Pass and Notch. The State Variable configuration is a stable, multiple loop system having distinct advantages over all other types.

Pin connections and a basic functional diagram are shown on the left. Four operational amplifiers are provided, three in the State Variable loop and one utility amplifier which is useful for acheiving totally independent adjustment of gain and "Q". It is also needed for notch filter configurations.

State Variable filters are two pole devices but may be cascaded for higher order requirements. OEI Application Note 10219 shows how Cauer, Bessel, Butterworth and Chebyshev filters may be created. Also shown is how the State Variable Filter may be used as a stable, dual-quadrature oscillator

At the left is a basic filter connection showing the simultaneous output of lo-pass, band-pass and hi-pass response. This configuration uses the internal RC components to acheive a 1.6kHz (approx) frequency for the 3704, 16kHz for the 3705 and 160kHz for the 3706.

Basic adjustability is shown at the left. This configuration uses all four operational amplifiers but the independent adjustments are attractive for general lab use.

A notch filter, using all four operational amplifiers, is also shown. The external potentiometer will have some tuning effect but should not be used for gross adjustment.

PDS3701R1 10M0171

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OEI NEW PRODUCT SUMMARY - NOVEMBER 1971

OPERATIONAL AMPLIFIERS

MODEL	OPEN LOOP GAIN	INPUT OFFSET DRIFT	INPUT BIAS CURRENT	OUTPUT VOLTAGE SWING	MAXIMUM OUTPUT CURRENT	GAIN BW PROD	SLEW RATE
9722	66dB	250µV/°C	50pA	±10V	±200mA	250MHz	±200V/µS
9724	90dB	100µV/°C	10pA	±10V	±100mA	300MHz	±1000V/µS
9725	50dB	150µV/°C	100pA	±10V	±200mA	300MHz	±200V/µS
9746	0.99	300µV/°C	30pA	±10V	±100mA	30Mhz	±600V/µS
9808	120dB	2.0µV/°C	100nA	±10V	±100mA	60MHz	±1800V/µS
D-90-032	114dB	1.0µV/°C	50nA	±10V	±5mA	200kHz	±5mV/µS
D-90-038	90dB	25µV/°C	30nA	±10V	±10mA	1MHz	±2V/µS
D-90-040	126dB	4.0µV/°C	20nA	±10V	±3mA	1MHz	±0.6V/µS
D-90-046	140dB	10µV/°C	50pA	±10V	±10mA	1MHz	±0.1V/µS
D-90-052	80dB	30µV/°C	300nA	±10V	±5mA	200MHz	±7.5V/µS
D-90-062	120dB	2.0µV/°C	100nA	±10V	±50mA	100Mhz	±750V/µS
D-90-063	120dB	1.0µV/°C	50pA	±10V	±5mA	1MHz	±1V/µS

LOGARITHMIC AMPLIFIERS

MODEL	DYNAMIC RANGE	HI-LEVEL BANDWIDTH	LOW-LEVEL BANDWIDTH	ERROR	FULL SCALE INPUT	VOLTS PER DECADE	NOTES
2533	60dB	3MHz	3MHz	±3%	10V	2.5	—
2534	100dB	100kHz	100Hz	±3%	1mA	UNIVERSAL	ARRAY
2538	80dB	100kHz	1kHz	±2%	10V	PROGRAMMABLE	
2540	100dB	10MHz	5MHz	±3%	10V	1.5	DUAL
D-20-005	100dB	10kHz	10Hz	±1%	10V	1.5	—
D-20-006	80dB	1kHz	1kHz	±1%	10V	1,10	2 MODES
396	80dB	1MHz	1MHz	±3%	260mV	60mV	ANTI-LOG
D-30-001	60dB	1kHz	1kHz	±1%	10V	1.5	ANTI-LOG

FREQUENCY - TO - VOLTAGE CONVERTERS

MODEL	INPUT FREQUENCY RANGE	RESPONSE TIME	FREQUENCY MODULATION BANDWIDTH	MINIMUM INPUT LEVEL	OTHER SPECIFICATIONS LIKE MODEL:
3327	0-2kHz	35mS	10Hz	100mVrms	3371
3328	0-5kHz	3.5mS	100Hz	100mVrms	3382
3330	0-20kHz	3.5mS	100Hz	300mVrms	3382
3331	0-50kHz	3.5mS	100Hz	500mVrms	3383
3332	0-500Hz	35mS	10Hz	100mVrms	3371
3333	0-200Hz	350mS	1Hz	100mVrms	3371

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PEAK SENSE AND HOLD MEMORIES

MODEL	FULL SCALE INPUT	TOTAL ERROR	MEMORY DECAY RATE	ACQUISITION TIME	RESET TIME
5146D	+10V	3%+30mV	300mV/S	100nS	3μS
5891	+10V	2%+40mV	100mV/S	250nS	50μS
5893	+10V	3%+10mV	10V/S	60nS	400nS
D-50-012	+10V	1%	5V/S	30nS	100nS

SAMPLE AND HOLD MEMORIES

MODEL	TOTAL ERROR	MEMORY DECAY RATE	FULL SCALE SIGNAL	LARGE SIGNAL BANDWIDTH	APERTURE TIME	ACQUISITION TIME
5886	0.1%+30mV	30mV/S	±10V	10kHz	1μS	20μS
5892	3%+30mV	30mV/S	±10V	300kHz	400nS	400nS
5894	2%+10mV	0	±10V	300kHz	1μS	1μS

MULTIPLIERS AND DIVIDERS

MODEL	TOTAL ERROR	LARGE SIGNAL BANDWIDTH	AVAILABLE FUNCTION EQUATIONS
5822B	±2%	DC-8MHz	XY/10: -5V<X,Y<+5V
5887	±1%	DC-25kHz	XY/10, $X^2/10$: DIFFERENTIAL
5895	±2%	DC-30kHz	X/Y: 10mV<X,Y<10V
5897	±1%	DC-1.5MHz	XY/10, $X^2/10$, $\sqrt{10Z}$, 10Z/X: DIFF.
D-50-020	±1%	DC-300kHz	XY/10, $X^2/10$

OTHER ANALOG FUNCTION MODULES

MODEL	TRANSFER FUNCTION	TRANSFER EQUATION	TOTAL ERROR	LARGE SIGNAL BANDWIDTH	FULL SCALE VOLTAGE
5712A	VECTOR	$\sqrt{X^2+Y^2}$	±3%	15kHz	±10V
5762A	COORDINATE CONV.	r SINθ, r COSθ	±3%	100kHz	±10V
5888	AGC AMPLIFIER	—	0.5dB	3MHz	±10V
5889	RMS	$\sqrt{(1/T)\int e_{in}^2 dt}$	±3%	1MHz	±10V
5890	PINCUSHION + FOCUS	SINGLE TERM	±1.7%	200kHz	±10V
8900	VARIABLE REFERENCE	0 to ±10V	0.5%+15mV	3kHz	±10V
9000	SUMMER	$-(e_1+....+e5)$	0.1%+10mV	5kHz	±10V
9001	FOLLOWER	$e_o=e_{in}$	0.01%+10mV	5kHz	±10V
9002	POSITIVE GATE	e_o=MOST+INPUT	0.01%+20mV	1kHz	±10V
9003	NEGATIVE GATE	e_o=MOST-INPUT	0.01%+20mV	1kHz	±10V
9004	ABS VALUE	$e_o\|e_{in}\|$	0.1%+10mV	1kHz	±10V
9005	LIMITER	$e_o=-e_{in}, -e_L<e_{in}<+e_L$	10mV	5kHz	±10V
9006	DEAD BAND	$e_o=e_{in}, -e_L>e_{in}>+e_L$	10mV	100kHz	±10V
9007	DIFFERENTIAL AMP	1<GAIN<1000	0.1%+1-mV	5kHz	±10V
9008	INTEGRATOR	$e_o=(-1/RC)\int e_{in} dt$	0.1%+10mV	5kHz	±10V
9009	DIFFERENTIATOR	$e_o=-RCde_{in}/dt$	0.1%+10mV	5kHz	±10V

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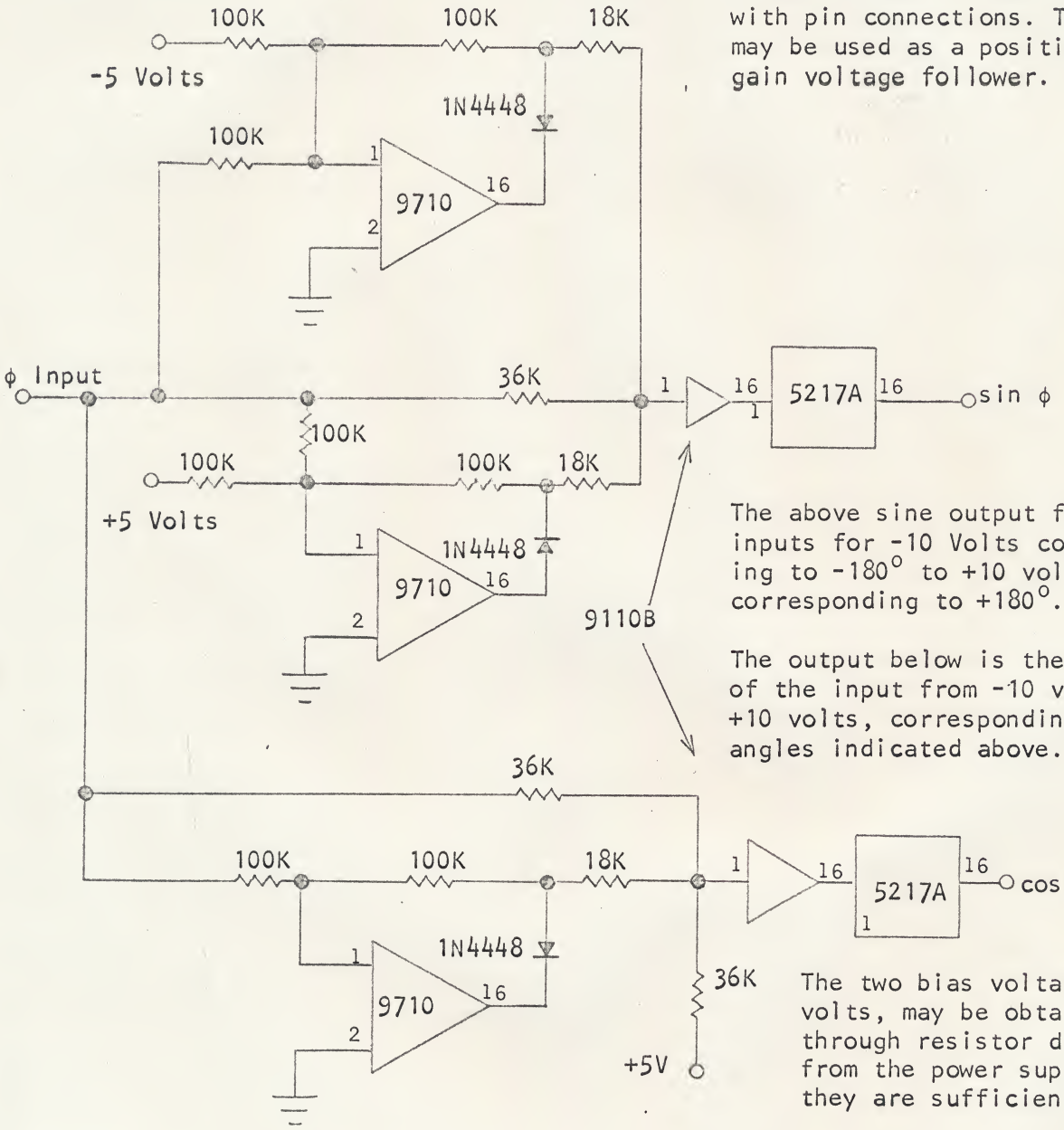
FEB 72

Sine module

360 DEGREE SINE/COSINE FUNCTION GENERATOR

Using two basic modules, a sine function and an operational amplifier, a four-quadrant or full 360° sine and cosine function can be created. The OEI Model 5217A the sine function module, generates the non-linear transfer function. The drive to the 5217A is created by three operational amplifier stages that operate on the input in a manner similar to rectification. A third type of module is shown to buffer the summing resistor network and to drive the 5217A. A Model 9110B is shown with pin connections. The 9710 may be used as a positive, unity gain voltage follower.



The above sine output follows inputs for -10 Volts corresponding to -180° to +10 volts corresponding to +180°.

The output below is the cosine of the input from -10 volts to +10 volts, corresponding to the angles indicated above.

The two bias voltages, ±5 volts, may be obtained through resistor dividers from the power supply if they are sufficiently stable.

Bandwidth of the circuit is quite good for the majority of applications. The useful bandwidth, preserving accuracy, is DC to 1kHz for all practical purposes. Much higher frequencies can be handled with greater dynamic error. Overall static accuracy is ±1%.

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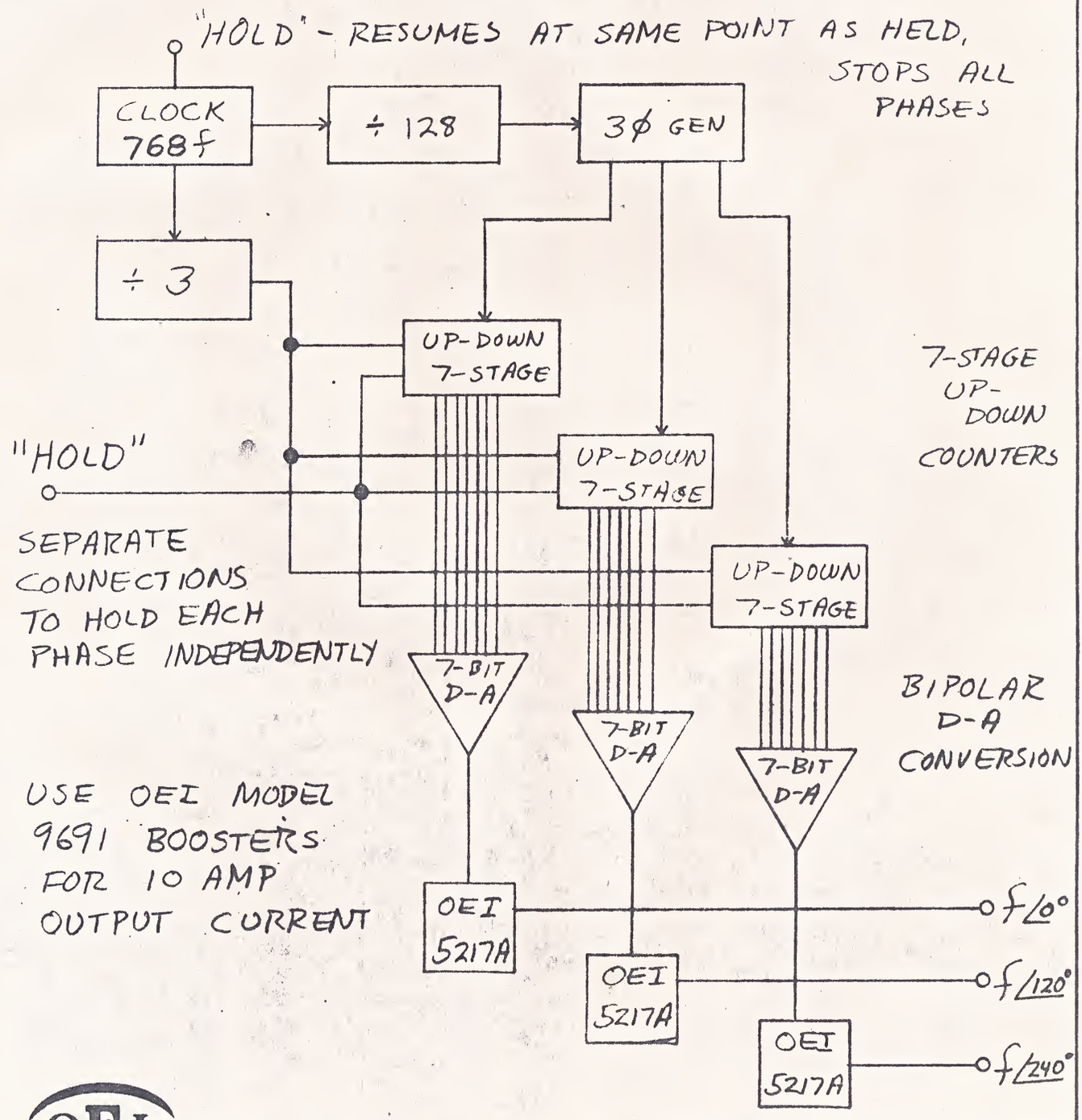
CB 14054

GENERATION OF 3-PHASE SINUSOIDAL SIGNAL CAPABLE OF INDEFINITE HOLD PERIODS



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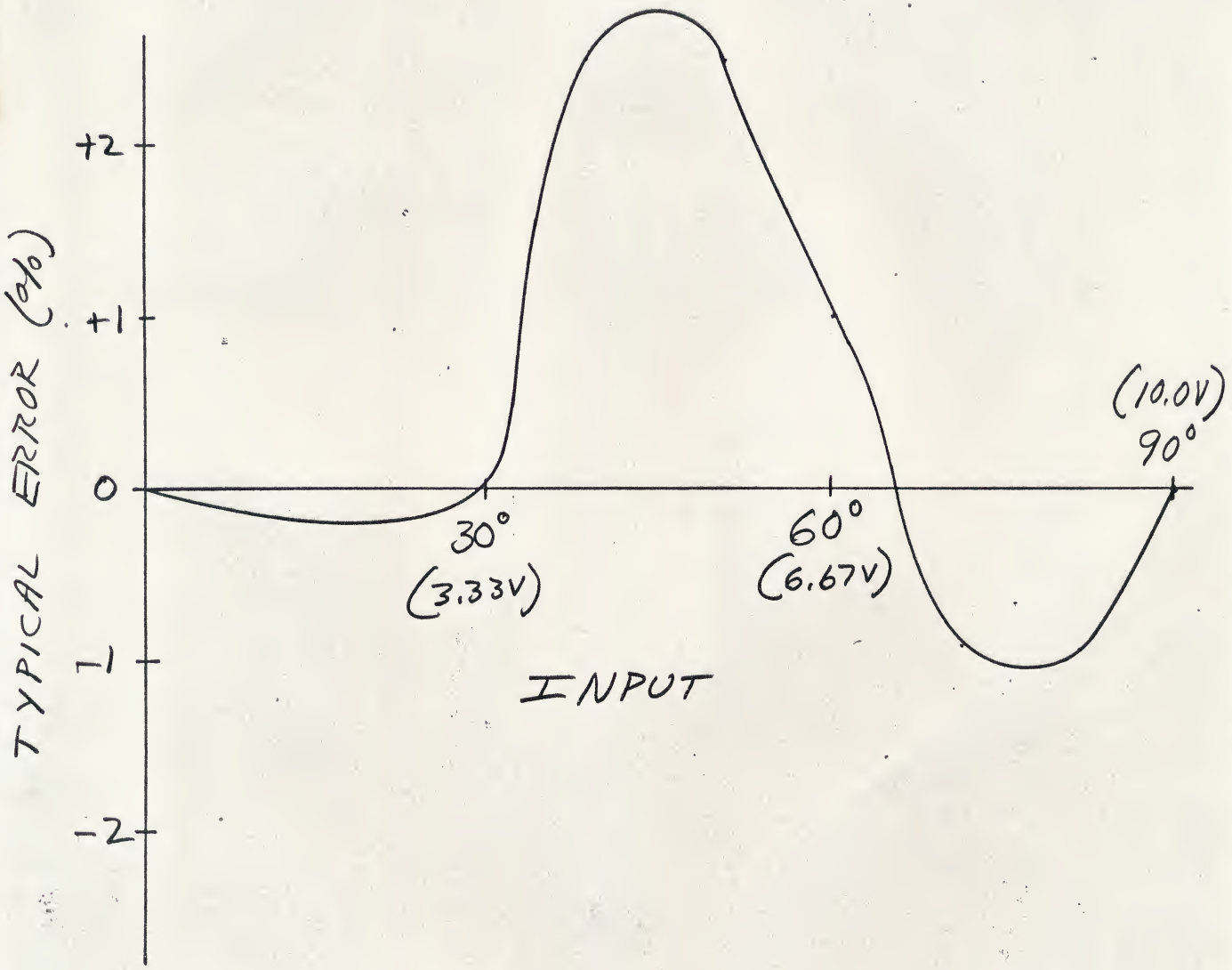
EN 13112

5217A TYPICAL ERROR



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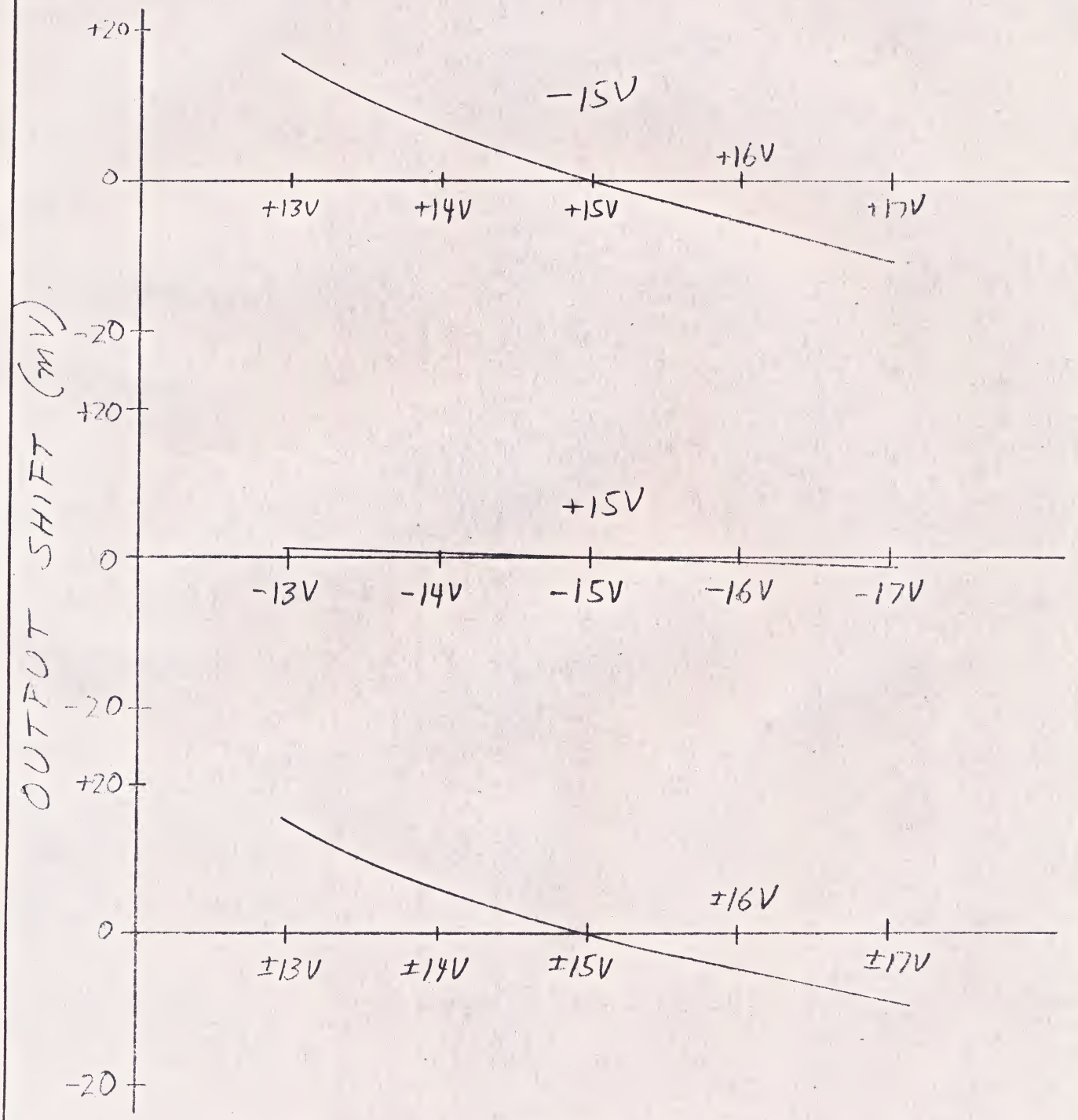
EN 13111

5217A POWER SUPPLY SENSITIVITY



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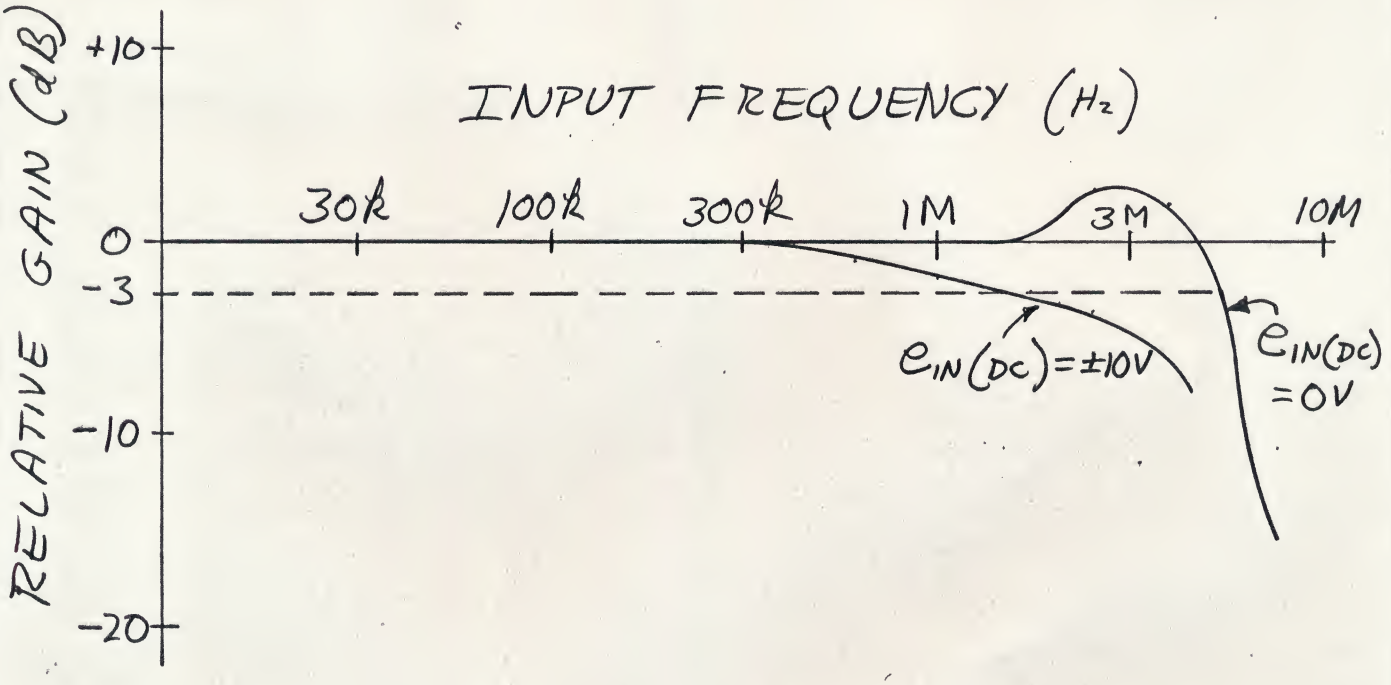
EN 13110

5217A FREQUENCY RESPONSE



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OPERATING AND APPLICATIONS MANUAL

MODEL 5217A

Serial Number _____

OEI

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Optical Electronics Inc.

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7.0 APPLICATIONS

8.0 CASE STYLE

9.0 WARRANTY

10.0 CONFORMANCE TO SPECIFICATIONS

OEI offers an Application Manual free of charge to customers. This $3.50 value has 100 application tips and technical tips covering the use and behavior of our products. Copies may be obtained, at no charge, by so requesting on purchase orders for other merchandise or by request on your company letterhead.

Also available, at no cost, is our Circuit Brief program. This offers a solution to your specific application problem. Ask OEI Applications Engineering for details.

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1.0	SPECIFICATIONS OF MODEL 5217A	
1.1	Transfer Function	Sinusoidal Function Module
1.2	Function Error	±1.0% of full scale typical ±3.0% of full scale Maximum
1.3	Input	
	1.3.1 Polarity	Bipolar
	1.3.2 Dynamic Voltage Range	-10 volts to +10 volts
	1.3.3 Impedance	15,000 ohms
1.4	Output	
	1.4.1 Dynamic Impedance	1.0 ohms
	1.4.2 Dynamic Voltage Range	-10 volts to +10 volts
	1.4.3 Trigonometric Range	$-\pi/2$ to $+\pi/2$
	1.4.4 Polarity	Non-inverted
1.5	Frequency Response	
	1.5.1 Small Signal	DC to 30kHz
	1.5.2 Large Signal	DC to 3kHz
1.6	Temperature Environment	
	1.6.1 Output Coefficient	±0.1% full scale/^{o}C
	1.6.2 Operating Range	-25^{o}C to +75^{o}C
	1.6.3 Storage Range	-55^{o}C to +85^{o}C
1.7	Power Required	
	1.7.1 Minimum Voltage	±5 volts
	1.7.2 Nominal Rated Voltage	±15 volts
	1.7.3 Maximum Voltage	±20 volts
	1.7.4 Quiescent Current	±2.5 milliamps
	1.7.5 Quiescent Power Dissipation	75 milliwatts
1.8	Size	1.0 inch square by 0.5 inch high

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SPECIFICATIONS OF MODEL 5217A continued

1.9	Weight	0.6 ounce
1.10	Socket	OEI Model 11016
1.11	MTBF-per-MIL-HDBK-217A	1,71,000 hours

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2.0 CIRCUIT DESCRIPTION. Model 5217A utilizes advanced circuit design using discrete components to generate a non-linear transfer function that simulates the sinusoidal transfer function. The sinusoidal function is valid from -90° to +90°, hence sine waves may be generated with this module using a triangular input wave form.

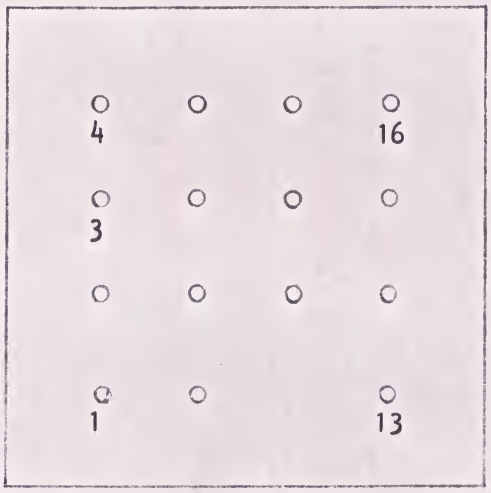
3.0 PHYSICAL ENVIRONMENTAL CONSIDERATIONS.

3.1 MOUNTING. This module may be plugged into an OEI Model 11016 socket or soldered onto a printed circuit board. When soldering, do not exceed 225° C for 10 seconds on each pin.

3.2 BREADBOARDING. When breadboarding circuitry using the 5217A, use the 11016 socket to solder the various leads and components. This eliminates the possibility of damaging the module by excessive soldering on the pins.

3.3 ENVIRONMENTAL. This module is designed to operate over the specified temperature range. Do not exceed these temperatures or permanent damage may result. Also, do not subject this module to excessive shock, vibration or moisture or in any way abuse the device.

4.0 ELECTRICAL CONNECTIONS. Shown below are the pins and the various connections to be made. Do not connect to any pin not identified below.



BOTTOM VIEW

PIN	CONNECTION
1	INPUT
3	COMMON
4	+V SUPPLY
13	-V SUPPLY
16	OUTPUT

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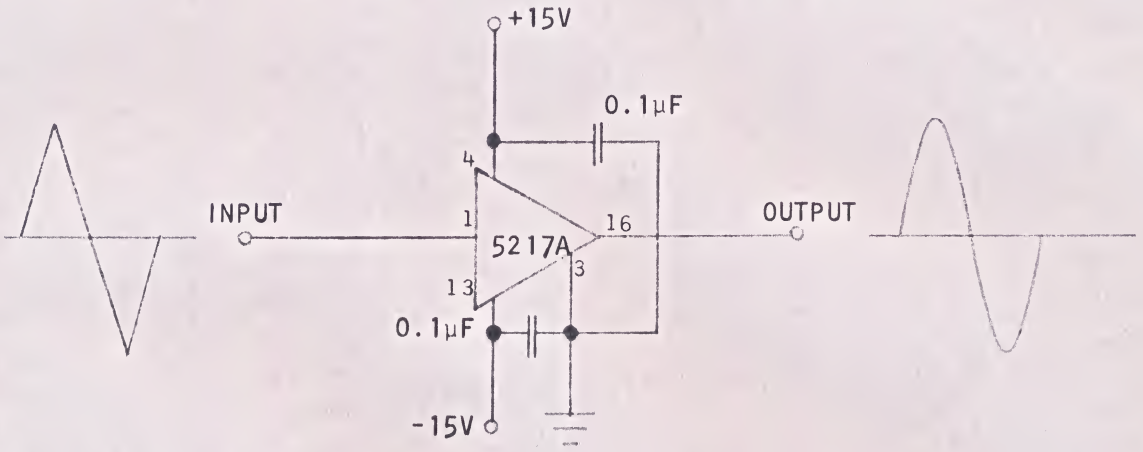
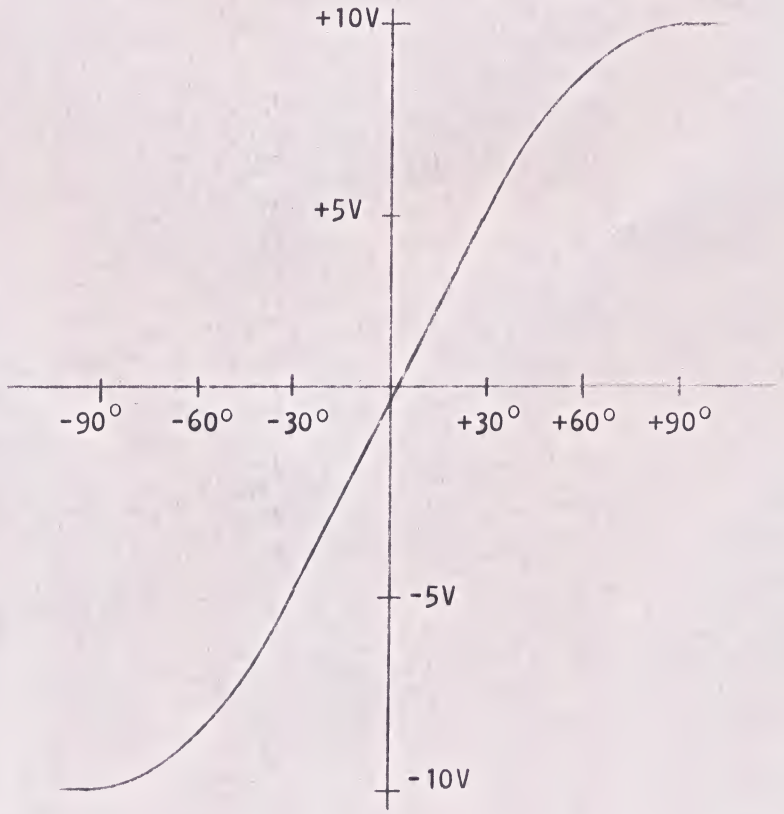
5.0 OPERATING CONDITIONS. Shown below is the primary application for the Model 5217A. Also shown below is a curve showing input versus output voltage relationships.

Conversion of a trinagular waveform to a sinusoidal waveform.



The above may also be a trigonometric computer for solving angles from linear information.

Typical Transfer Function



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6.0 IN CASE OF DIFFICULTY. When using the 5217A, error is the most common problem and this is due to the mismatching of input voltage to input characteristic of the individual unit. For best accuracy, the drive voltage should be controllable and this can be done as shown with an external resistor to the module. For best overall accuracy and stability, ambient temperature should be held relatively constant.

If undue difficulty is experienced in using the 5217A, please contact OEI Applications Engineering for assistance.

7.0 APPLICATIONS. The following application tips are available for the 5217A:

10151 - A Vertical Height Trigonometric Computer.
10154 - 360° Sine/Cosine Function Generator.

Please request the latest application information from OEI.

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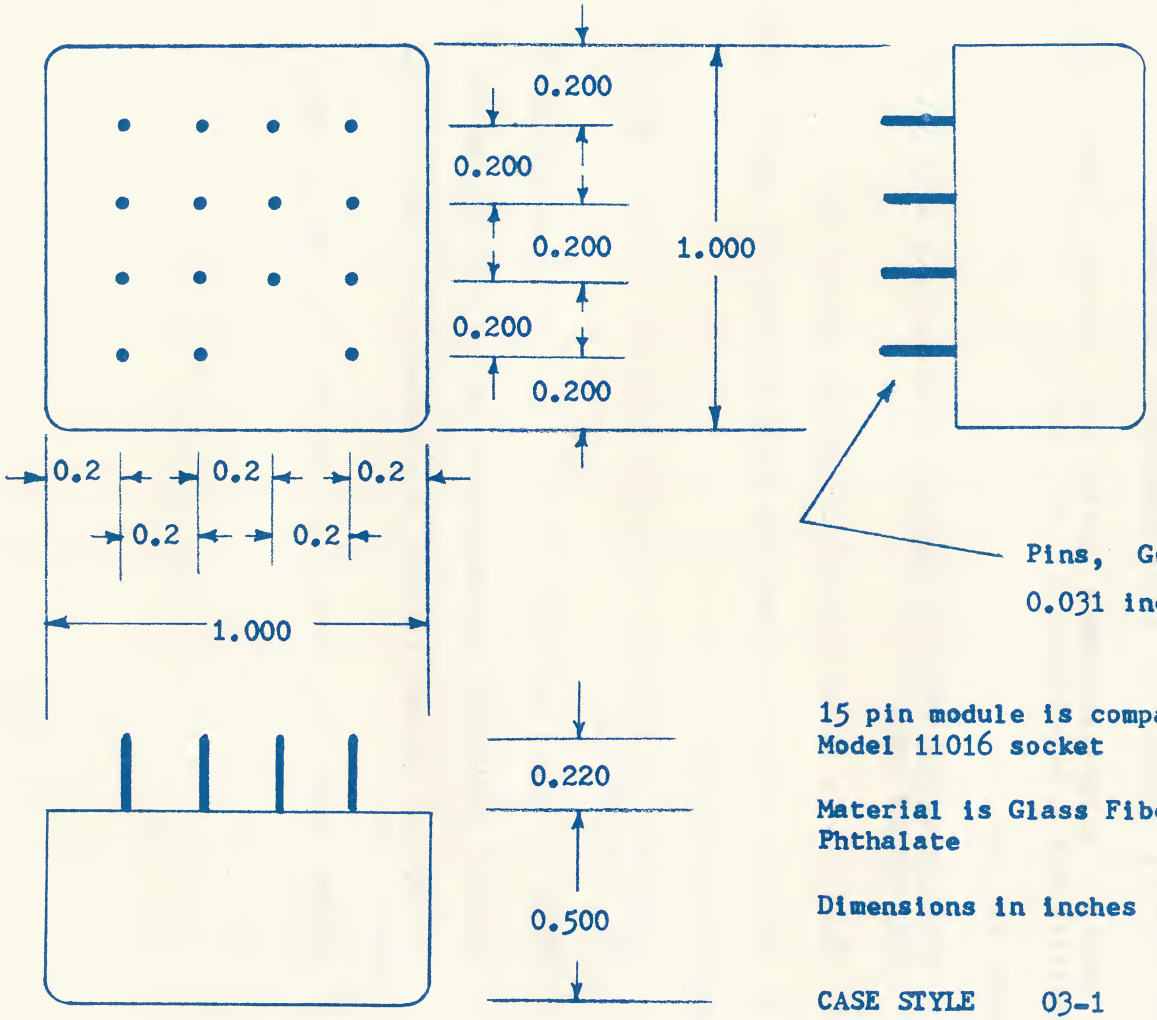

15 pin module is compatible with OEI Model 11016 socket

Material is Glass Fiber filled Diallyl-Phthalate

Dimensions in inches

CASE STYLE 03-1 R1

OEI TUCSON 3/67

8.1 SOCKETS. Case 03-1 uses an OEI Model 11016 socket. This is recommended for breadboarding and circuit development. The socket is not generally used on a production basis.

8.2 PHYSICAL PROPERTIES. The material used on the outside surface of this module is Diallyl-Phthalate per MIL-M-14F, SDG.

Pins are 1/2-hard brass, gold plated. Each pin is numbered on the pin side. Numbers are molded.

This module meets many of the environmental and mechanical tests of MIL-STD-883. Contact OEI Sales Department for details.

This module is a non-repairable, potted unit, having a high electrical reliability and a rugged physical construction.

8.3 PHYSICAL TESTING

8.3.1 PHYSICAL DIMENSIONS are measured in accordance with MIL-STD-750, Method 2066.

8.3.2 SOLDERING is tested using MIL-STD-750, Method 2031.

8.3.3 TERMINAL STRENGTH is measured using MIL-STD-750, Method 2036.

8.4 ENVIRONMENTAL TESTING

8.4.1 VIBRATION is tested in accordance with MIL-STD-202, Method 204, Condition D.

8.4.2 SHOCK is tested using MIL-STD-202, Method 205, Condition C.

8.4.3 MOISTURE RESISTANCE is measured using MIL-STD-750, Method 1021.

8.4.4 TEMPERATURE CYCLING is done in accordance with MIL-STD-750, Method 1051.

8.4.5 THERMAL SHOCK is performed with MIL-STD-750, Method 1056.

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WARRANTY

This product is guaranteed to be free of defects under normal operating conditions, as specified, for a period of one year from date of shipping from the factory of OPTICAL ELECTRONICS, INC.

If the product contains vacuum tubes and/or incadescent lamps, these items are warranted for a period of 90 days from date of shipment.

If the product is received in a damaged and/or non-operating condition, contact the Common Carrier at once. Failure to do so within 30 days from receipt of merchandise will void the warranty. OPTICAL ELECTRONICS, INC. is not responsible for the condition of received products. Conformance to specifications at the time of shipment is certified.

This warranty applies only to the original customer and is in lieu of all other warranties, expressed or implied. Under no condition will OPTICAL ELECTRONICS, INC. be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the customer in connection with the purchase and/or use of the product.

In case of failure within the warranty period, DO NOT RETURN the product without contacting the factory to receive shipping and labeling instructions. Shipping must be done at customers expense.

Products will be accepted for free in-warranty repair or replacement only at the factory of OPTICAL ELECTRONICS, INC.

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CONFORMANCE TO SPECIFICATIONS

Model_____

Serial Number_____

This model is final checked at the factory using automatic test equipment. Optical Electronics, Inc. certifies that the above identified product meets or exceeds all published specifications.

To obtain actual test data, contact the factory for details and cost information.

Electrical_____100 hour burn in_____

Environmental_____Special Instructions_____

Physical_____ _____

External resistors_____

_____

_____

External capacitors_____

_____

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OEI

OPTICAL ELECTRONICS INC.

P.O. BOX 11140
TUCSON, ARIZONA 85706

(602) 624-8358

'YOUR OPTICAL ELECTRONICS FUTURE'

OPTICAL ELECTRONICS INC.

OEI was formed in early 1964 as an Arizona corporation. The basic premise of OEI is to provide our customers with the best available product, performance-wise and price-wise, that is unique in the market as far as parameters are concerned.

OEI is leading the industry in high frequency and high power operational amplifiers and other related analog products. Our quality control manual conforms to MIL-Q-9858A, MIL-1-45208 and MIL-C-45662. All modules receive a 100 hour, high temperature operating burn-in.

USING THIS CATALOG

This catalog is a complete listing of all measured, specified and guaranteed data on standard available products. Included in this catalog is a general categorization of each product, complete worst case specifications and estimated mean time before failure data obtained in accordance to MIL-HDBK-217A.

APPLICATIONS

OEI has an extensive treatment of applications and discussions of various technical aspects pertaining to the measurement of parameters and the selection of modules for specific applications. This book, entitled "APPLICATION OF OEI PRODUCTS" is available at $3.50 each or at no charge when specified on a purchase order of $50 or more.

BIPOLAR
OPERATIONAL AMPLIFIERS

- ±1000 V/µS SLEW RATE (9278)
- 100 MHz CLOSED LOOP BANDWIDTH (9251)
- PULSE AMPLIFIERS
- VIDEO AMPLIFIERS
- VERY FAST COMPARATORS

CASE 29

MODEL →	976A	9186B	9251	9278A	9406
General Description	General Purpose	High Performance	Widest Bandwidth	Fast-Low Power	Lowest Cost
Minimum Open Loop Gain	50dB	60dB	30dB	70dB	57dB
Minimum Input Impedance Differential	3kΩ	3kΩ	2kΩ	1	5kΩ
Minimum Input Impedance Common Mode	100kΩ	30MΩ	30kΩ	10k	500kΩ
Common Mode Rejection at 1kHz	70dB	80dB	30dB	1	80dB
Common Mode Rejection at 1kHz	40dB	60dB	30dB	1	50dB
Maximum Input Noise[2]	15µV	15µV	30µV	15µV	15µV
Maximum Input Voltage Differential	5V	5V	2V	1V	5V
Maximum Input Voltage Common Mode	5V	8.5V	1V	3V	6V
Maximum Input Offset Voltage[3]	10mV	10mV	50mV	20mV	10 mV
Maximum Offset Voltage Drift	+250µV/°C	+200µV/°C	+400µV/°C	±100µV/°C	±100µV/°C
Maximum Bias Current	30µA	30µA	20µA	1	10µA
Maximum Input Offset Current	10µA	10µA	7µA	1	1µA
Maximum Offset Current Drift	±100nA/°C	±30nA/°C	±20nA/°C	1	±100nA/°C
Power Supply Sensitivity	±3mV/V	±1mV/V	±10mV/V	±1mV/V	±3mV/V
Output Voltage Swing	±10V	±10V	±1.5V	±10V	±10V
into a load resistance of	3kΩ	2.5kΩ	100Ω	300Ω	3.3kΩ
Open Loop Output Impedance	1kΩ	30Ω	10Ω	3kΩ	1kΩ
Slewing Rate	±250V/µS	±600V/µS	±200V/µS	±1000V/µS	±300V/µS
Maximum Full Output Frequency	4MHz	10MHz	15MHz	15MHz	5MHz
Gain Bandwidth Product	300MHz	600MHz	300MHz	30MHz	1000MHz
Open Loop -3dB Frequency	2MHz	1MHz	6MHz	30kHz	1MHz
Maximum Closed Loop Bandwidth[4]	10MHz	25MHz	100MHz	20MHz	70MHz
Settling Time to 0.1% error[5]	160nS	80nS	22nS	140nS	105nS
Operating Temperature Range	-55 to +75°C	-55 to +75°C	-55 to +75°C	-55 to +85°C	-55 to +85°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (rated) Voltage Minimum	±9V	±6V	±3V	±12V	±9V
Power Supply (rated) Voltage Nominal	±15V	±15V	±6V	±15V	±15V
Power Supply (rated) Voltage Maximum	±18V	±18V	±9V	±18V	±18V
Power Supply Current (Quiescent)	±30mA	±30mA	±30mA	±10mA	±20mA
Power Dissipation (Quiescent)	900mW	900mW	360mW	300mW	600mW
Case [6]	03	03	23	23	29
Weight	0.6 oz	0.6 oz	0.36 oz	0.36oz	0.2 oz
Socket - Model	11016	11016	11016	11016	11020
MTBF - per MIL-HDBK-217A	472,000 Hrs	250,000 Hrs	287,000 Hrs	206,000 Hrs	600,000 Hrs

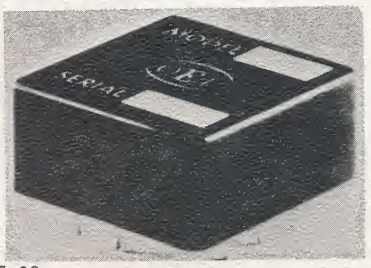
NOTES:

1. Model 9278 has a differential input with unbalanced characteristics. It is intended to be used in low power, non-inverting applications.
2. Noise is measured over a 1MHz bandwidth, integrated by a peak-to-peak detector over a 10 second period of time.
3. Input offset voltage may be trimmed to zero externally.
4. Maximum bandwidth is limited, primarily, by propagation delay and is measured at unity gain, but applies to higher gain levels up to the gain-bandwidth product limit.
5. Settling time is measured at unity gain with a 10 volt step (except 1.5 volt step for Model 9251).
6. Case 03 measures 1.0 inch square by 0.5 inch high. Case 23 measures 1.0 inch square by 0.31 inch high. Case 29 measures 0.75 inch diameter by 0.43 inch high.

OEI Optical Electronics Inc. BOX 11140, TUCSON, ARIZONA 85706 (602) 624-8358

BIPOLAR
OPERATIONAL AMPLIFIERS

- ±0.5 AMP OUTPUT CURRENT (9684)
- ±0.6μV/°C (9487)
- QUINTUPLE OP-AMP ARRAY (9432)
- ACTIVE FILTERS
- VIDEO LINE DRIVERS
- D→A CONVERTERS



CASE 03

MODEL →	9412	9428	9432	9487	9684
General Description	Fast-High Power	Fast-Low Power	Quintuple Array	Computer Grade	High Power
Minimum Open Loop Gain	50dB	80dB	90dB	126dB	94dB
Minimum Input Impedance Differential	3kΩ	3kΩ	500kΩ	100MΩ	2MΩ
Minimum Input Impedance Common Mode	30MΩ	10MΩ	300MΩ	1GΩ	300MΩ
Common Mode Rejection at 1kHz	70dB	90dB	100dB	140dB	100dB
Common Mode Rejection at 1MHz	60dB	60dB	——	100dB	——
Maximum Input Noise[1]	15μV	15μV	10μV	5μV	10μV
Maximum Input Voltage Differential	5V	5V	25V	10V	25V
Maximum Input Voltage Common Mode	11V	5V	12V	12V	12V
Maximum Input Offset Voltage[2]	7.5mV	10mV	5mV	3mV	5mV
Maximum Offset Voltage Drift	+150μV/°C	±100μV/°C	±5μV/°C	±1μV/°C	±10μV/°C
Maximum Bias Current	30μA	30μA	200nA	30nA	50nA
Maximum Input Offset Current	3μA	10μA	50nA	5nA	10nA
Maximum Offset Current Drift	±30nA/°C	±300nA/°C	±2nA/°C	±5pA/°C	±100pA/°C
Power Supply Sensitivity	±5mV/V	±1mV/V	±50μV/V	±100μV/V	±50μV/V
Output Voltage Swing	±10V	±10V	±10V	±10V	±10V
into a load resistance of	50Ω	300Ω	1kΩ	1kΩ	20Ω
Open Loop Output Impedance	30Ω	1kΩ	2kΩ	300Ω	3Ω
Slewing Rate	±200V/μS	±500V/μS	±0.2V/μS	±30V/μS	±0.3V/μS
Maximum Full Output Frequency	3MHz	8MHz	3kHz	500kHz	5kHz
Gain Bandwidth Product	300MHz	1GHz	300kHz	100MHz	3MHz
Open Loop -3dB Frequency	1MHz	100kHz	10Hz	10Hz	10Hz
Maximum Closed Loop Bandwidth[3]	60MHz	100MHz	300kHz	2.5MHz	3MHz
Settling time to 0.1% error[4]	50nS	70nS	20μS	1μS	2μS
Operating Temperature Range	-55 to +65°C	-55 to +75°C	-55 to +85°C	-25 to +75°C	-55 to +55°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Minimum	±9V	±6V	±3V	±9V	±4V
Power Supply (Rated) Nominal	±15V	±15V	±15V	±15V	±15V
Power Supply (Rated) Maximum	±18V	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)	±35mA	±3mA	±9mA	±22mA	±2mA
Power Dissipation (Quiescent)	1050mW	90mW	270mW	660mW	60mW
Case[5]	23	03	37	03	03
Weight	0.36 oz	0.6 oz	1.2 oz	0.6 oz	0.7 oz
Socket - Model	11016	11016	——	11016	11016
MTBF-per MIL-HDBK-217A	435,000 Hrs	802,000 Hrs	454,000 Hrs	1,079,000 Hrs	1,206,000 Hrs

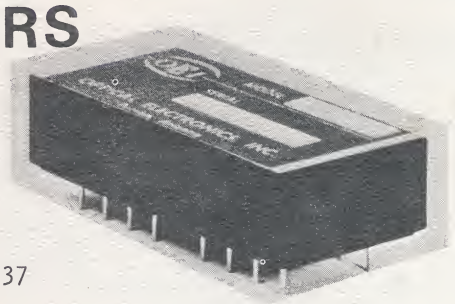
NOTES:

1. Noise is measured over a 1MHz bandwidth integrated by a peak-to-peak detector over a 10 second period of time.
2. Input offset voltage may be externally trimmed to zero, except for Model 9487.
3. Maximum bandwidth is limited, primarily, by the propagation delay for Models 9412, 9428 and 9487. It is measured at unity gain but is the same for higher gain levels up to the Gain-Bandwidth product limit. Models 9432 and 9684 are Gain-Bandwidth product limited.
4. Settling time is measured at unity gain with a 10 volt step.
5. Case 03 measures 1.0 inch square by 0.5 inch high. Case 23 measures 1.0 inch square by 0.31 inch high. Case 37 measures 2.0 inch by 1.0 inch by 0.5 inch high.

OEI Optical Electronics Inc. P. O. Box 11140 Tucson, Arizona 85706 (602) 624-8358

Bipolar
OPERATIONAL AMPLIFIERS

- WIDEST CLOSED LOOP BANDWIDTH (9491)
- 12nS - 0.1% SETTLING TIME (9491)
- 140dB OPEN LOOP GAIN (9696)
- ACTIVE FILTERS
- D→A CONVERTERS
- PRECISION FAST COMPARATORS



Case 37

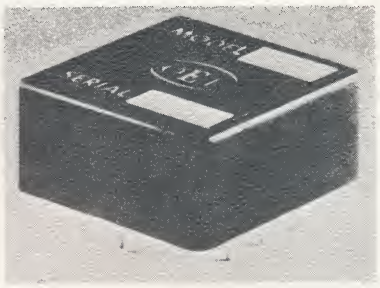
MODEL →	9491	9688	9692	9694	9696
General Description	Ultra-Wide Bandwidth	General Purpose	D→A Converters	Fast-Low Cost	Highest Performance
Minimum Open Loop Gain	50dB	94dB	80dB	76dB	140dB
Minimum Input Differential	10kΩ	100MΩ	10MΩ	10MΩ	100MΩ
Impedance Common Mode	1MΩ	1GΩ	1GΩ	1GΩ	1GΩ
Common Mode at 1kHz	50dB	50dB	60dB	90dB	140dB
Rejection at 1MHz	50dB	50dB	30dB	50dB	100dB
Maximum Input Noise[1]	30μV	15μV	15μV	15μV	5μV
Maximum Input Differential	±5V	±15V	±15V	±15V	±10V
Voltage Common Mode	±1V	±3V	±6V	±12V	±12V
Maximum Input Offset Voltage[2]	20mV	15mV	15mV	15mV	3mV
Maximum Offset Voltage Drift	±200μV/°C	±50μV/°C	±50μV/°C	±50μV/°C	±1μV/°C
Maximum Bias Current	75μA	100nA	100nA	100nA	30nA
Maximum Input Offset Current	10μA	20nA	30nA	15nA	5nA
Maximum Offset Current Drift	100nA/°C	1nA/°C	1nA/°C	1nA/°C	5pA/°C
Power Supply Sensitivity	±300μV/V	±1mV/V	±1mV/V	±300μV/V	±100μV/V
Output Voltage Swing	±5V	±10V	±4V	±10V	±10V
into a load resistance of	180Ω	50Ω	100Ω	100Ω	100Ω
Open Loop Output Impedance	100Ω	5kΩ	50Ω	200Ω	10Ω
Slewing Rate	±1000V/μS	±250V/μS	±150V/μS	±100V/μS	±10V/μS
Maximum Full Output Frequency	30MHz	4MHz	4.5MHz	1.5MHz	1.5MHz
Gain Bandwidth Product	450MHz	200MHz	100MHz	100MHz	20MHz
Open Loop -3dB Frequency	1.5MHz	20kHz	20kHz	10kHz	2Hz
Maximum Closed Loop Bandwidth[3]	300MHz	12MHz	12MHz	10MHz	10MHz
Settling time to 0.1% error[4]	12nS	200nS	70nS	500nS	200nS
Operating Temperature Range	-25 to +75°C	-55 to +75°C	-25 to +85°C	-55 to +75°C	-55 to +75°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Minimum	±12V	±12V	±9V	±6V	±9V
Supply (Rated) Nominal	±15V	±15V	±15V	±15V	±15V
Voltage Max-mum	±18V	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)	±25mA	±12mA	±15mA	±7mA	±22mA
Power Dissipation (Quiescent)	750mW	360mW	450mW	210mW	660mW
Case	03	37	03	29	03
Weight	0.6oz	1.2oz	0.6oz	0.2oz	0.6oz
Socket - Model	11016	___	11016	11020	11016
MTBF - per MIL-HDBK-217A	387,000Hrs	648,000Hrs	300,000Hrs	399,000Hrs	884,000Hrs

NOTES:
1. Noise is measured over a 1MHz bandwidth integrated by a peak-to-peak detector over a 10 second period of time.
2. Input offset voltage may be externally trimmed to zero.
3. Maximum bandwidth is limited by the propagation delay of the amplifier for Model 9688. It is measured at unity gain and is the same until the gain - bandwidth product is reached. Models 9491, 9692, 9694 and 9696 are gain - bandwidth product limited.
4. Settling time is measured at unity gain with a 10 volt step for Models 9688, 9694 and 9696. A 5 volt step for Model 9491 and a 4 volt setp for Model 9692.
5. Case 03 measures 1.0 inch square by 0.5 inch high. Case 29 is 0.75 inch diameter by 0.44 inch high. Case 37 is 2.0 inch by 1.0 inch by 0.5 inch high.

OEI
Optical Electronics Inc.
(602) 624-8358
P. O. Box 11140 Tucson, Arizona 85706

Power
OPERATIONAL AMPLIFIERS

- 10 AMP OUTPUT (9687)
- ±100V/µS SLEW RATE (9695)
- 90mW QUIESCENT POWER (9685)
- CABLE AND LINE DRIVERS
- DEFLECTION AMPLIFIERS
- SERVO SYSTEMS



Case 03

MODEL →	9685	9686	9687	9695
General Description	1 Amp Output	3 Amp Output	10 Amp Output	Fast 0.5 Amp
Minimum Open Loop Gain	90dB	90dB	90dB	80dB
Minimum Input Impedance Differential	500kΩ	500kΩ	500kΩ	50MΩ
Minimum Input Impedance Common Mode	300MΩ	300MΩ	300MΩ	300MΩ
Common Mode Rejection at 1kHz	100dB	100dB	100dB	90dB
Maximum Input Noise[1]	10µV	10µV	10µV	15µV
Maximum Input Voltage Differential	±25V	±25V	±25V	±15V
Maximum Input Voltage Common Mode	±12V	±12V	±12V	±11V
Maximum Input Offset Voltage[2]	5mV	5mV	5mV	7.5mV
Maximum Offset Voltage Drift	±5µV/°C	±5µV/°C	±5µV/°C	±10µV/°C
Maximum Bias Current	200nA	200nA	200nA	100nA
Maximum Input Offset Current	50nA	50nA	50nA	30nA
Maximum Offset Current Drift	2nA/°C	2nA/°C	2nA/°C	0.3nA/°C
Power Supply Sensitivity	±50µV/V	±50µV/V	±50µV/V	±200µV/V
Output Voltage Swing	±10V	±10V	±10V	±10V
into a load resistance of	10Ω	3.0Ω	1.0Ω	20Ω
Open Loop Output Impedance	3Ω	1Ω	0.3Ω	10Ω
Slewing Rate	±0.06V/µS	±0.1V/µS	±0.1V/µS	±100V/µS
Maximum Full Output Frequency	1kHz	1.5kHz	1.5kHz	1.5MHz
Gain Bandwidth Product	300kHz	300kHz	300kHz	20MHz
Open Loop -3dB Frequency	10Hz	10Hz	10Hz	1.5kHz
Maximum Closed Loop Bandwidth[3]	100kHz	100kHz	100kHz	10MHz
Settling time to 0.1% error[4]	100µS	100µS	100µS	900nS
Operating Temperature Range	-25°C to +70°C	-25°C to +70°C	-25°C to +70°C	-25°C to +75°C
Storage Temperature Range	-55°C to +85°C	-55°C to +85°C	-55°C to +85°C	-65°C to +85°C
Power Supply (Rated) Minimum	±4V	±5V	±6V	±6V
Power Supply (Rated) Nominal	±15V	±15V	±15V	±15V
Power Supply (Rated) Maximum	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)	±3mA	±40mA	±60mA	±15mA
Power Dissipation (Quiescent)	90mW	1200mW	1800mW	450mW
Case[5]	03	37	38	03
Weight	0.8oz	1.6oz	6oz	0.6oz
Socket - Model	11016	—	—	11016
MTBF-per MIL-HDBK-217A	1,409,000Hrs	889,000Hrs	646,000Hrs	1,409,000Hrs

NOTES.

1. Noise is measured over a 1MHz bandwidth integrated by a peak-to-peak detector over a 10 second period of time.
2. Input offset voltage may be externally trimmed to zero.
3. Maximum closed loop bandwidth is limited by the available open loop gain (gain bandwidth product).
4. Settling time is measured at unity gain with a 10 volt step.
5. Case 03 measures 1.0 inch square by 0.5 inch high. Model 9685 has a removable heatsink that increases the overall height to 1.25 inch. Case 37 is 2.0 inch by 1.0 inch by 0.5 inch high. It has a removable heat sink that increases its height to 1.25 inch. Case 38 is 3.25 inches by 1.5 inch by 0.6 inch high. A removable heat sink increases the height to 1.563 inch.

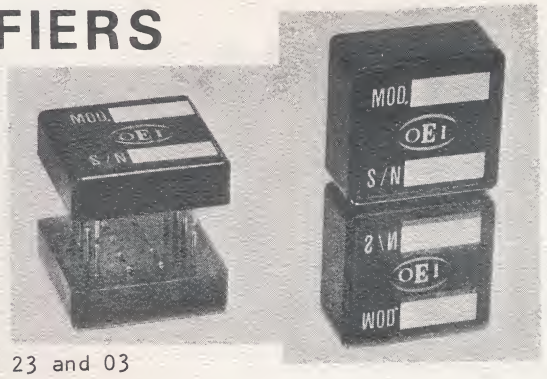
OEI

Optical Electronics Inc. P. O. Box 11140 Tucson, Arizona 85706

(602) 624-8358

High Voltage
OPERATIONAL AMPLIFIERS

- ±75 VOLT SWING (9699)
- ±1000V/µS SLEWING RATE (9698)
- ±1.0 AMP OUTPUT (9800)
- VIDEO AMPLIFIERS
- DEFLECTION DRIVERS
- UNIVERSAL AMPLIFIERS



Case 23 and 03

MODEL →	9697	9698	9699	9800
General Description	General Purpose ±50V	Current Booster-Follower	Highest Performance ±75V	Power Current Booster
Minimum Open Loop Gain	76dB	0.93	80dB	0.95
Minimum Input Impedance Differential	5kΩ	—	10MΩ	—
Minimum Input Impedance Common Mode	10MΩ	10MΩ	1GΩ	10kΩ
Common Mode Rejection at 1kHz	60dB	—	80dB	—
Common Mode Rejection at 1MHz	30dB	—	30dB	—
Maximum Input Noise[1]	15µV	30µV	15µV	30µV
Maximum Input Voltage Differential	±5V	—	±15V	—
Maximum Input Voltage Common Mode	±50V	±50V	±75V	±75V
Maximum Input Offset Voltage[2]	20mV	100mV	15mV	400mV
Maximum Offset Voltage Drift	±200µV/°C	±200µV/°C	±50µV/°C	±2mV/°C
Maximum Bias Current	5µA	5µA	100nA	500µA
Maximum Input Offset Current	1µA	—	30nA	—
Maximum Offset Current Drift	10nA/°C	—	1nA/°C	—
Power Supply Sensitivity	±300µV/V	±300µV/V	±1mV/V	±1mV/V
Output Voltage Swing	±50V	±50V	±75V	±75V
into a load resistance of	2500Ω	1000Ω	7500Ω	75Ω
Open Loop Output Impedance	1000Ω	30Ω	1000Ω	3Ω
Slewing Rate	±100V/µS	±1000V/µS	±200V/µS	±30V/µS
Maximum Full Output Frequency	300kHz	3MHz	600kHz	70kHz
Gain - Bandwidth Product	100MHz	—	100MHz	—
Open Loop -3dB Frequency	30kHz	60MHz	3kHz	10MHz
Maximum Closed Loop Bandwidth[3]	6MHz	60MHz	10MHz	10MHz
Settling Time to 0.1% error[4]	500nS	120nS	500nS	300nS
Operating Temperature Range	-25 to +75°C	-55 to +85°C	-55 to +75°C	-25 to +70°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Minimum	±10V	±3V	±12V	±2V
Power Supply (Rated) Nominal	±60V	±60V	±80V	±80V
Power Supply (Rated) Maximum	±75V	±90V	±90V	±90V
Power Supply Current (Quiescent)	±14mA	±8mA	±15mA	±1mA
Power Dissipation (Quiescent)	1680mW	960mW	2400mW	160mW
Case[5]	23	23	37	37
Weight	0.36 oz	0.36 oz	1.2 oz	1.6 oz
Socket - Model	11016	11016	—	—
MTBF-per MIL-HDBK-217A	354,000 Hrs	273,000 Hrs	124,000 Hrs	4,771,000 Hrs

NOTES:

1. Noise is measured over a 1MHz bandwidth integrated by a peak-to-peak detector over a 10 second period of time.
2. Input offset voltage may be externally trimmed to zero.
3. Maximum Bandwidth is limited by propagation delay for Models 9697 and 9699. Frequency response (gain-bandwidth) limits the 9698 and 9800.
4. Settling time is measured exclusive of delay and slewing rate times. Total acquisition time is the sum of the settling time, the voltage swing divided by the slewing rate and the reciprocal of the maximum closed loop bandwidth.
5. Case 23 measures 1.0 inch square by 0.31 inch high. Case 37 is 2.0 inch by 1.0 inch by 0.5 inch high. Model 9800 has a removable heat sink that increases the heighth to 1.25 inch.

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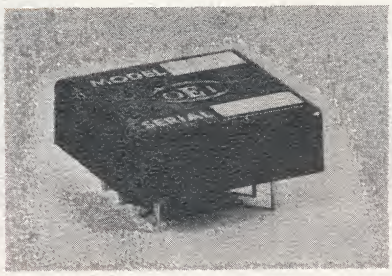
(602) 624-8358

Optical Electronics Inc. P. O. Box 11140 Tucson, Arizona 85706

FET OPERATIONAL AMPLIFIERS

- 300 MHz UNITY GAIN FREQUENCY (9712)
- ±500 V/µS SLEW RATE (9524)
- ±200 mA OUTPUT CURRENT (9712)
- FAST COMPARATORS
- VIDEO AMPLIFIERS
- LOGARITHMIC AMPLIFIERS



CASE 23

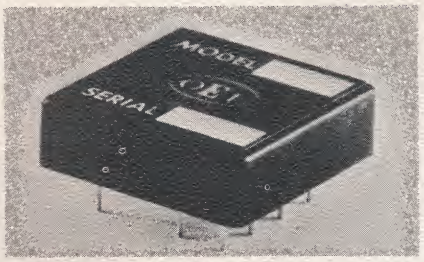
MODEL[7]→	9245A	9524	9706	9712	9776
General Description	General Purpose	General Purpose	Fast-Low Cost	High Power	Fast-General Purpose
Minimum Open Loop Gain	70dB	80dB	57dB	50dB	50dB
Minimum Input Resistance — Differential	10GΩ	10GΩ	10GΩ	10GΩ	10GΩ
Minimum Input Resistance — Common Model	10GΩ	10GΩ	10GΩ	10GΩ	10GΩ
Maximum Input Capacitance — Differential	4pf	5pf	4pf	4pf	4pf
Maximum Input Capacitance — Common Mode	6pf	5pf	6pf	6pf	6pf
Common Mode Rejection at 1kHz	90dB	100dB	80dB	70dB	70dB
Common Mode Rejection at 1MHz	40dB	60dB	60dB	50dB	50dB
Maximum Input Noise [1]	20µV	10µV	20µV	20µV	20µV
Maximum Input Voltage — Differential	±25V	±25V	±25V	±25V	±25V
Maximum Input Voltage — Common Mode	±4V	±8V	±7V	±11V	±5V
Maximum Input Offset Voltage[2]	20mV	10mV	10mV	10mV	10mV
Maximum Offset Voltage Drift	+200µV/°C	±300µV/°C	±150µV/°C	±150µV/°C	+250µV/°C
Maximum Input Bias Current[3]	100pA	100pA	100pA	100pA	100pA
Maximum Input Offset Current[3]	30pA	30pA	30pA	30pA	30pA
Power Supply Sensitivity	±2mV/V	±4mV/V	±3mV/V	±3mV/V	±3mV/V
Ouptut Voltage Swing	±10V	±10V	±10V	±10V	±10V
into a load resistance of	3kΩ	100Ω	3.3kΩ	50Ω	3kΩ
Open Loop Output Impedance	300Ω	100Ω	30Ω	30Ω	30Ω
Slewing Rate	±150V/µS	±500V/µS	±300V/µS	±200V/µS	±250V/µS
Maximum Full Output Frequency	2MHz	8MHz	5MHz	3MHz	4MHz
Gain-Bandwidth Product	300MHz	300MHz	1GHz	300MHz	300MHz
Open Loop -3dB Frequency	200kHz	50kHz	1MHz	1MHz	2MHz
Maximum Closed Loop Bandwidth[4]	6MHz	10MHz	20MHz	30MHz	6MHz
Settling Time to 0.1% error[5]	560nS	700nS	120nS	60nS	175nS
Operating Temperature Range	-55 to +75°C	-25 to +75°C	-55 to +85°C	-55 to +65°C	-55 to +75°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Voltage — Minimum	±6V	±10V	±9V	±9v	±9V
Power Supply (Rated) Voltage — Nominal	±15V	±15V	±15V	±15V	±15V
Power Supply (Rated) Voltage — Maximum	±18V	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)	±30mA	±30mA	±40mA	±35mA	±50mA
Power Dissipation (Quiescent)	900mW	900mW	1200mW	1050mW	1500mW
Case[6]	03	03	23	23	23
Weight	0.6oz	0.6oz	0.36oz	0.36oz	0.36oz
Socket - Model	11016	11016	11016	11016	11016
MTBF-per MIL-HDBK-217A	264,000HrsrH	893,000Hrs	1,590,000Hrs	959,000Hrs	1,354,000Hrs

NOTES:
1. Noise is measured over a 1MHz bandwidth, integrated by a peak-to-peak detector over a 10 second period of time.
2. Input offset voltage may be externally trimmed to zero.
3. Input bias and offset current will approximately double every 10C°.
4. Maximum bandwidth is limited, primarily, by the propagation delay and is measured at unity gain, but applies to higher gain levels up to the gain-bandwidth product limit.
5. Settling time is measured at unity gain with a 10 volt step.
6. Case 03 measures 1.0 inch square by 0.5 inch high. Case 23 is 1.0 inch square by 0.31 inch high.
7. Models 9712 and 9776 are direct plug-in FET equivalents to OEI bipolar Models 9412 and 976A, respectively. Model 9706 is an electrical FET equivalent to the bipolar Model 9406.

OEI Optical Electronics Inc. BOX 11140, TUCSON, ARIZONA 85706 (602) 624-8358

FET
OPERATIONAL AMPLIFIERS

- "INFINITE" INPUT IMPEDANCE (9708)
- ±0.5μV/°C DRIFT (9709)
- ±1000V/μS SLEW RATE (9728)
- FAST SAMPLE AND HOLD MEMORIES
- VIDEO AMPLIFIERS
- ELECTROMETERS



Case 23

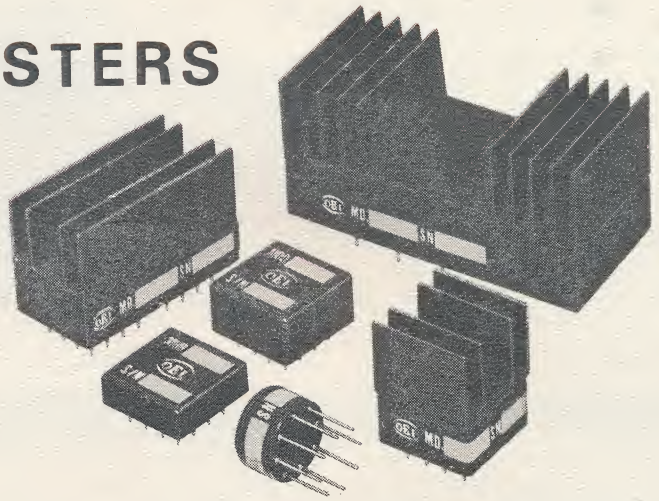
MODEL[7] →	9708	9709	9710	9711	9728
General Purpose	High Zin Follower	Low Drift	General Purpose	Fast-Hi Power	Fastest FET
Minimum Open Loop Gain	1.000	140dB	100dB	74dB	60dB
Minimum Input Resistance Differential	——	10GΩ	10GΩ	10GΩ	10GΩ
Minimum Input Resistance Common Mode	100TΩ	10GΩ	10GΩ	10GΩ	10GΩ
Maximum Input Capacitance Differential	——	3pF	3pF	3pF	4pF
Maximum Input Capacitance Common Mode	1.0pF	5pF	5pF	5pF	6pF
Common Mode Rejection at 1kHz	——	100dB	100dB	90dB	80dB
Common Mode Rejection at 1MHz	——	——	80dB	20dB	30dB
Maximum Input Noise[1]	5μV	3μV	10μV	15μV	20μV
Maximum Input Voltage Differential	——	±30V	±30V	±30V	±25V
Maximum Input Voltage Common Mode	±11V	±12V	±10V	±12V	±3V
Maximum Input Offset Voltage[2]	10mV	1mV	10mV	15mV	10mV
Maximum Offset Voltage Drift	±10μV/°C	±10μV/°C	±10μV/°C	±100μV/°C	±100μV/°C
Maximum Input Bias Current[3]	10fA	50pA	50pA	50pA	100pA
Maximum Input Offset Current[3]	——	10pA	10pA	10pA	30pA
Power Supply Sensitivity	±100μV/V	±30μV/V	±300μV/V	±2mV/V	±2mV/V
Output Voltage Swing into a load resistance of	±10V 1kΩ	±10V 1kΩ	±10V 1kΩ	±10V 100Ω	±10V 300Ω
Open Loop Output Impedance	0.01Ω	200Ω	100Ω	1kΩ	1kΩ
Slewing Rate	±0.3V/μS	±0.3V/μS	±6V/μS	±100V/μS	±1000V/μS
Maximum Full Output Frequency	5kHz	5kHz	100kHz	1.5MHz	15MHz
Gain - Bandwidth Product	——	1MHz	20MHz	60MHz	100MHz
Open Loop -3dB Frequency	300kHz	0.1Hz	10Hz	10kHz	100kHz
Maximum Closed Loop Bandwidth[4]	300kHz	300kHz	10MHz	6MHz	30MHz
Settling time to 0.1% error[5]	20μS	20μS	3μS	400nS	100nS
Operating Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +75°C	-55 to +75°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Minimum	±6V	±6V	±5V	±7V	±9V
Power Supply (Rated) Nominal	±15V	±15V	±15V	±15V	±15V
Power Supply (Rated) Maximum	±18V	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)	±12mA	±10mA	±4mA	±15mA	±12mA
Power Dissipation (Quiescent)	360mW	300mW	120mW	450mW	360mW
Case[6]	03	03	23	23	03
Weight	0.6oz	0.6oz	0.36oz	0.36oz	0.6oz
Socket - Model	——	11016	11016	11016	——
MTBF per MIL-HDBK-217A	276,000 Hrs	438,000 Hrs	522,000 Hrs	331,000 Hrs	691,000 Hrs

NOTES:
1. Noise is measured over a 1MHz bandwidth, integrated by a peak-to-peak detector over a 10 second period of time.
2. Input Offset voltage may be externally trimmed to zero.
3. Input bias and offset current will approximately double every 10C°.
4. Maximum closed loop bandwidth is limited, primarily, by the propagation delay for the 9728. It is measured at unity gain, but applies to any gain level up to the gain - bandwidth product limit. Models 9708, 9709, 9710 and 9711 are gain - bandwidth limited.
5. Settling time is measured at unity gain with a 10 volt step.
6. Case 03 measures 1.0 inch square by 0.5 inch high. Case 23 is 1.0 inch square by 0.31 inch high.
7. Model 9728 is an electrical FET equivalent to the bipolar Model 9428. Model 9708 is a committed unity gain positive voltage follower optimized for this mode of operation.

OEI
602 624 8358
Optical Electronics Inc.
P. O. Box 11140 Tucson, Arizona 85706

UNITY GAIN
HIGH CURRENT BOOSTERS

- 10 AMP OUTPUT (9691)
- 1MΩ INPUT IMPEDANCE
- ±300V/μS SLEWING RATE (9689)
- SERVO SYSTEMS
- DEFLECTION AMPLIFIERS
- HIGH-EFFICIENCY AUDIO SYSTEMS



MODEL →	9689	9690	9691	9693
General Description	1 Amp Booster	3 Amp Booster	10 Amp Booster	100mA Booster
Voltage Gain Typical	0.95	0.95	0.90	0.97
Voltage Gain Maximum	0.90	0.85	0.80	0.93
Minimum Input Impedance	50kΩ	1MΩ	1MΩ	10MΩ
Maximum Input Bias Current	300μA	1μA	1μA	1μA
Maximum Input Voltage	±12V	±11V	±11V	±12V
Maximum Offset Voltage	200mV	300mV	500mV	100mV
Maximum Input Voltage Drift	±200μV/°C	±300μV/°C	±1mV/°C	±200μV/°C
Output Voltage Swing	±10V	±10V	±10V	±10V
into a load resistance of	10Ω	3.3Ω	1.0Ω	100Ω
Maximum Output Impedance[1]	5Ω	3Ω	1Ω	10Ω
Slewing Rate	±300V/μS	±100V/μS	±30V/μS	±400V/μS
Maximum Full Output Frequency	5MHz	1.5MHz	500kHz	6MHz
Minimum Small Signal Bandwidth	30MHz	10MHz	10MHz	20MHz
Operating Temperature Range	-25 to +70°C	-25 to +70°C	-25 to +70°C	-55 to +85°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Voltage Minimum	±3V	±4V	±5V	±6V
Power Supply (Rated) Voltage Nominal	±15V	±15V	±15V	±15V
Power Supply (Rated) Voltage Maximum	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)	±40mA	±40mA	±75mA	±10mA
Power Dissipation (Quiescent)	1200mW	1200mW	2250mW	300mW
Case[2]	03	37	38	23
Weight	0.8oz	1.6oz	6oz	0.36oz
Socket - Model	11016	——	——	11016
MTBF - per MIL-HDBK-217A	2,202,000 Hrs	1,538,000 Hrs	954,000 Hrs	526,000 Hrs

NOTES:
1. Output impedance is, to some extent, a function of source impedance. Figures shown are for a source impedance equal to the input impedance.
2. Case 03 measures 1.0 inch square by 0.5 inch high. It has a removable heat sink that increases the overall height to 1.25 inch. Case 37 is 2.0 inch by 1.0 inch by 0.5 inch high. A removable heat sink increases the height to 1.25 inch. Case 38 is 3.25 inches by 1.5 inch by 0.6 inch high. A removable heat sink increases the height to 1.563 inch.

OEI Optical Electronics Inc.
(602) 624-8358
P. O. Box 11140 Tucson, Arizona 85706

AMPLIFIERS / CURRENT BOOSTERS (UNITY GAIN)

- ±0.5 AMP OUTPUT CURRENT (9682)
- FET INPUT (9146A)
- 100 MHz BANDWIDTH (9510)

MODEL →	9110B	9146A	9162A	9510	9682
General Description	General Purpose	FET Fast Follower	Fast Booster	100MHz Booster	High Power
Voltage Gain Typical	0.97	1.00	0.95	0.97	0.95
Voltage Gain Minimum	0.95	0.99	0.90	0.95	0.90
Minimum Input Impedance	100kΩ	10GΩ	1000Ω	10kΩ	50kΩ
Maximum Input Bias Current	100µA	100pA	10mA	3mA	300µA
Maximum Input Voltage	±12V	±10V	±13V	±12V	±12V
Maximum Input Offset Voltage	100mV	20mV	100mV	100mV	200mV
Maximum Offset Voltage Drift	±200µV/°C	±100µV/°C	±200µV/°C	±300µV/°C	±200µV/°C
Output Voltage Swing[1]	±10V	±10V	±10V	±10V	±10V
into a load resistance of	100Ω	3kΩ	50Ω	300Ω	20Ω
Maximum Output Impedance[2]	10Ω	30Ω	10Ω	10Ω	5Ω
Slewing Rate	±900V/µS	±600V/µS	±1800V/µS	±2000V/µS	±600V/µS
Maximum Full Output Frequency	15MHz	10MHz	30MHz	33MHz	10MHz
Minimum Small Signal Bandwidth	40MHz	30MHz	30MHz	100MHz	40MHz
Operating Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-25 to +50°C	-25 to +70°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Minimum	±6V	±9V	±3V	±3V	±3V
Power Supply (Rated) Nominal	±15V	±15V	±15V	±15V	±15V
Voltage Maximum	±18V	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)	±10mA	±18mA	±12mA	±40mA	±40mA
Power Dissipation (Quiescent)	300mW	540mW	360mW	1200mW	1200mW
Case[3]	23	03	03	29	03
Weight	0.36oz	0.6oz	0.6oz	0.2oz	0.7oz
Socket - Model	11016	11016	11016	11020	11016
MTBF - per MIL-HDBK-217A	526,000Hrs	448,000Hrs	255,000Hrs	2,385,000Hrs	1,447,000Hrs

NOTES:
1. Output current capability of the Model 9510 may be increased to a swing of ±10 volts across 100 ohm load by two external resistors.
2. Output impedance of Models 9110B, 9162A, 9510 and 9682 is, to some extent, a function of source impedance. Figures shown are for a source impedance equal to the input impedance.
3. Case 03 measures 1.0 inch by 0.5 inches high. Case 23 is 1.0 inch square by 0.31 inch high. Case 29 is 0.75 inch diameter by 0.43 inch high

POWER SUPPLIES

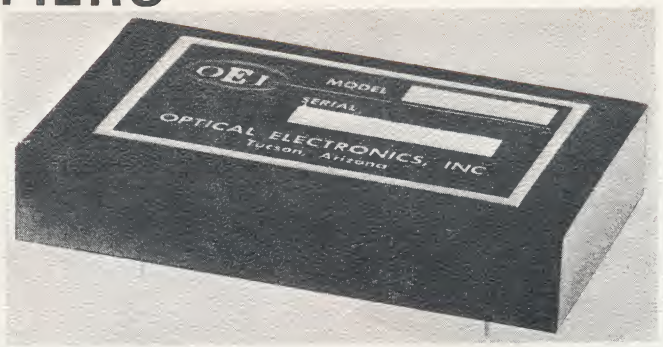
- SINGLE OR DUAL
- COMPLETELY SHORT CIRCUIT PROOF

MODEL →	885	887	888	892
General Description	single	single	single	dual
Output Voltage[1] (±2%)	6V	15V	24V	±15V
Minimum Output Current Limit	200mA	100mA	50mA	±100mA
Load Regulation	±0.05%	±0.02%	±0.02%	±0.02%
Line Regulation	±0.05%	±0.02%	±0.02%	±0.02%
Output Impedance (at 10kHz)	0.2Ω	0.2Ω	0.2Ω	0.2Ω
Temperature Coefficient	±0.05%/°C	±0.02%/°C	±0.02%/°C	±0.02%/°C
Derating above +55°C	10mA/°C	5mA/°C	2.5mA/°C	5mA/°C
Derating below +15°C	2mA/°C	1mA/°C	0.5mA/°C	1mA/°C
Operating Temperature Range	0 to +70°C	0 to +70°C	0 to +70°C	0 to +70°C
Storage Temperature Range	-25 to +85°C	-25 to +85°C	-25 to +85°C	-25 to 85°C
Input Power Voltage	105 to 125VAC	105 to 125VAC	105 to 125VAC	105 to 125VAC
Input Power Frequency	60-400Hz	60-400Hz	60-400Hz	60-400Hz
Case[2]	46	40	40	41

NOTES:
1. The output voltage may be externally trimmed by ±10%.
2. Case 40 measures 2.25 inches by 1.75 inches by 1.0 inch high. Case 41 is 3.5 inches by 2.3 inches by 1.0 inch high. Case measures 3.0 inches by 2.0 inch by 1.0 inch high.

Bipolar
LOGARITHMIC AMPLIFIERS

- UP TO 160dB DYNAMIC RANGE (2519)
- UP TO 6MHz BANDWIDTH (2357)
- 100 PPM TEMPERATURE COEFFICIENT (2245C)
- COMPLEMENTARY ANTI-LOG MODULES
- DATA COMPRESSION
- NON-LINEAR GENERATION
- MULTIPLIERS - DIVIDERS



CASE 36

MODEL →		2245C	2357	2507	2519	2531
General Description		Precision General Purpose	Low-Cost Wide-Band Current	Low-Cost General Purpose	Wide Range Current	Wide-Band General Purpose
Dynamic Range		80dB	80dB	80dB	160dB	80dB
Logarithmic Error[1]	Maximum	±1%	±2%	±1%	±2%	±3%
	Typical	±0.6%	±1%	±0.7%	±0.7%	±1%
60dB Error[1]		±0.3%	±0.7%	±0.5%	±0.5%	±0.7%
Input Impedance	Voltage	10GΩ	——	10kΩ	——	1kΩ
	Current	1.0Ω	100Ω	1.0Ω	1.0Ω	——
Input Voltage[2]	Minimum	±1.0mV	——	±1.0mV	——	±1.0mV
	Maximum	±10V	——	±10V	——	±10V
Input Current	Minimum	±30nA	±1µA	±100nA	±100pA	——
	Maximum	±300µA	±10mA	±1mA	±10mA	——
Input Offset	Voltage[3]	±3mV	±10mV	±3mV	±3mV	±1mV
	Drift	±5µV/°C	±100µV/°C	±5µV/°C	±100µV/°C	±100µV/°C
Input Bias Current[3]		±30nA	±50µA	±50nA	±10pA	±1µA
Output Coefficient		∿1.5V/dec	∿70mV/dec	∿1V/dec	∿1V/dec	∿2V/dec
Output Voltage	Minimum	±4V	±400mV	±3V	±2.5V	±1.5V
	Maximum	±10V	±700mV	±7V	±10V	±10V
Polarity[4]		NI	INV	INV	NI	NI
Output Impedance		1.0Ω	30Ω	1.0Ω	1.0Ω	1.0Ω
Minimum Load Resistance		1kΩ	200Ω	3kΩ	1kΩ	50Ω
Frequency Response[5]	Small Signal	100kHz	6MHz	100kHz	100kHz	10MHz
	Large Signal	10kHz	6MHz	10kHz	3kHz	3MHz
Low Level Bandwidth		10kHz	1kHz	100Hz	1Hz	100kHz
Output Temperature Coefficient		±0.01%FS/°C	-0.3%FS/°C	±0.03%FS/°C	±0.03%FS/°C	±0.03%FS/°C
Operating Temperature Range		-55 to +75°C	-55 to +75°C	-55 to +85°C	-25 to +75°C	-25 to +75°C
Storage Temperature Range		-55 to +85°C	-55 to +85°C	-55 to +100°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Voltage	Minimum	±12V	±9V	±12V	±9V	±10V
	Nominal	±15V	±15V	±15V	±15V	±15V
	Maximum	±18V	±18V	±18V	±18V	±18V
Power Supply Current (Quiescent)		±25mA	±25mA	±25mA	±9mA	±55mA
Power Dissipation (Quiescent)		750mW	750mW	750mW	270mW	1650mW
Case[6]		36	23	03	36	46
Weight		2oz	0.36oz	0.6oz	2oz	8oz
Socket - Model		——	11016	11016	——	——
MTBF-per MIL-HDBK-217A		194,000 Hrs	1,566,000Hrs	181,000Hrs	303,000Hrs	151,000Hrs
Anti-Log Companion - Model		395	376	395	395	376

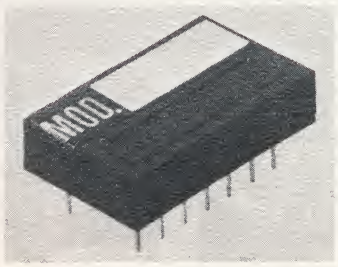
NOTES:

1. Error is defined as the deviation of the output from the theoretical output, established by the minimum and full scale output values.
2. Input voltage levels may be changed by using an external resistor connected to the current input (except Model 2531).
3. Input offset voltage and bias current may be externally reduced to zero, if desired.
4. Output polarity is inverted from the input for INV, non-inverted for NI.
5. The frequency response, small signal, is measured at full scale (between 90% and 100%) on an incremental basis. The large signal response is a measure of slewing rate limitations (0 to 100%). The low level bandwidth is measured at the minimum input level on an incremental basis (±5% of level).
6. Case 03 measures 1.0 inch square by 0.5 inch high. Case 23 is 1.0 inch square by 0.31 inch high. Case 36 is 2.5 inches by 1.5 inch by 0.5 inch high. Case 46 measures 3.0 inches by 2.5 inches by 1.0 inch high.

OEI Optical Electronics Inc. P. O. Box 11140 Tucson, Arizona 85706

Versatile
LOGARITHMIC ELEMENTS

- UP TO 120dB DYNAMIC RANGE (2255A)
- BIPOLAR OR UNIPOLAR
- UP TO 10MHz BANDWIDTH
- CASCADABLE FOR LARGE BANDWIDTH/DYNAMIC RANGE (2532)
- HYBRID (2523)



CASE 45

MODEL[7] →	2255A	2421	2457	2523	2532
General Description	General Purpose Element	Wide-Band Element	Element Amplifier Combination	Hybrid Multiple Element	Wide Band Cascadable Amplifier
Dynamic Range	120dB	60dB	100dB	100dB	20dB
Logarithmic Error[1] Maximum	±3%	±3%	±3%	±3%	±1%
Logarithmic Error[1] Typical	±1%	±1%	±1%	±1%	±0.3%
60dB Error[1]	±0.6%	——	±0.3%	±0.6%	——
Element Current[2] Minimum	1nA	1µA	10nA	10nA	100µA[3]
Element Current[2] Maximum	1mA	1mA	1mA	1mA	1mA[3]
Element Voltage[4] Minimum	1V	40mV	200mV	350mV	160mV[3]
Element Voltage[4] Maximum	7V	220mV	550mV	700mV	220mV[3]
Element Voltage Coefficient	∿1V/dec	∿60mV/dec	∿69mV/dec	∿65mV/dec	∿60mV/dec
Useful Bandwidth[5]	100kHz	10MHz	100kHz	100kHz	10MHz
Element Temperature Coefficient	±700µV/°C	-2mV/°C	±180µV/°C	-2mV/°C	-2mV/°C
Operating Temperature Range	-55 to +75°C	-55 to +75°C	-55 to +85°C	-25 to +75°C	-25 to +75°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Minimum	±12V	——	±12V	——	±12V
Power Supply (Rated) Nominal	±15V	——	±15V	——	±15V
Power Supply (Rated) Maximum	±18V	——	±18V	——	±18V
Power Supply Current (Quiescent)	±12mA	——	±33mA	——	±19mA
Power Dissipation (Quiescent)	360mW	——	990mW	——	570mW
Case[6]	03	29	37	45	03
Weight	0.6oz	0.2oz	1.3oz	0.1oz	0.6oz
Socket - Model	11016	11020	——	——	11016
MTBF - per MIL-HDBK-217A	148,000Hrs	83,000Hrs	452,000Hrs	1,653,000Hrs	140,000Hrs

NOTES:
1. Error is defined as the deviation of the output from the theoretical output, established by the minimum and full scale output values.
2. Maximum current may be increased to 3mA at some sacrifice in accuracy.
3. Model 2532 is an active building block intended for cascaded operation for large dynamic range-wide bandwidth requirements. It has a full scale input and output of 1 volt for this purpose.
4. Maximum and minimum element voltages coincide with the maximum and minimum current levels.
5. Useful bandwidth is indicative of the element impedance level. Actual bandwidth is dependent on the operational amplifier characteristics used with the element.
6. Case 03 measures 1.0 inch square by 0.5 inch high. Case 29 is 0.75 inch in diameter by 0.44 inch high. Case 37 measures 2.0 inches by 1.0 inch by 0.5 inch high. Case 45 is 0.8 inch by 0.5 inch by 0.2 inch high - dual inline.
7. Model 2457 is a module containing 4-unipolar temperature compensated log elements and 3-741 type operational amplifiers. Model 2532 is a module designed for cascaded operation as a building block.

OEI Optical Electronics Inc. P. O. Box 11140 Tucson, Arizona 85706

NON-LINEAR
FUNCTION MODULES

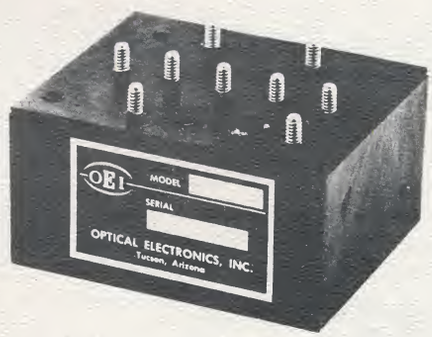
- VECTOR-AVERAGE-RMS (5712)
- e^t FUNCTIONS (5249A)
- CIRCLE GENERATION (5748)
- CO-ORDINATE CONVERSION (5762)
- SINUSOIDAL FUNCTIONS (5217A)

Case 03

MODEL →	5249A	5712	5217A	5748	5762
Function	$(X/10)^Y$	$\sqrt{X^2 + Y^2}$	sinX	sinX + cosX	r sinθ+r cosθ
General Description	Universal Non-Linear	Average-RMS-Vector	Low Cost	Circle Generator	Coordinate Converter
Maximum Function Error	±3%	±3%	±3%	±3%	±3%
Typical Function Error	±1%	±1%	±1%	±1%	±1%
Full Scale Input Voltage[1]	±10V	±10V	±10V	±10V	±10V
Input Impedance	10kΩ	50kΩ	15kΩ	2.5kΩ	2.5kΩ
Functional Range[2]	$^1/_3$<Y<3	10V F.S.	-90° to 90°	-180° to 180°	-180° to 180°
Maximum Output Voltage	±10V	±10V	±10V	±10V	±10V
Minimum Load Resistance	1kΩ	1kΩ	1kΩ	1kΩ	1kΩ
Output Impedance	1.0Ω	1.0Ω	1.0Ω	1.0Ω	1.0Ω
Frequency Response-small signal	100kHz	100kHz	30kHz	10kHz	100kHz
Frequency Response-large signal	30kHz	10kHz	3kHz	3kHz	30kHz
Output Temperature Coefficient	±0.1%/°C	±0.1%FS/°C	-0.1%FS/°C	±0.1%/°C	±0.1%/°C
Operating Temperature Range	-25 to +75°C	-25 to +75°C	-25 to +75°C	-25 to +75°C	-25 to +75°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Minimum	±14V	±12V	±5V	±12V	±12V
Power Supply (Rated) Nominal	±15V	±15V	±15V	±15V	±15V
Power Supply (Rated) Maximum	±18V	±18V	±20V	±18V	±20V
Power Supply Current (Quiescent)	±30mA	±20mA	±2.5mA	±18mA	±22mA
Power Dissipation (Quiescent)	900mW	600mW	75mW	540mW	660mW
Case[3]	02	02	03	02	02
Weight	11 oz	11 oz	0.6 oz	11 oz	11 oz
Socket - Model	—	—	11016	—	—
MTBF - per MIL HDBK 217A	238,000 Hrs	277,000 Hrs	1,071,000 Hrs	387,000 Hrs	225,000 Hrs

NOTES:
1. Model 5249A X-input is restricted to positive polarities.
2. Full Scale Input and Output Voltage of the 5712 is ±10V. Inputs may be limited to less than 10V if the function exceeds 10V.
3. Case 02 measures 3.0 inches by 2.5 inches by 1.5 inch. Case 03 is 1.0 inch square by 0.5 inch high.

OEI manufactures a complete line of logarithmic modules with anti-logarithmic complements. See the log amplifier catalog page for details. We also manufacture a complete line of operational amplifiers, power supplies and other analog modules for your system requirements.



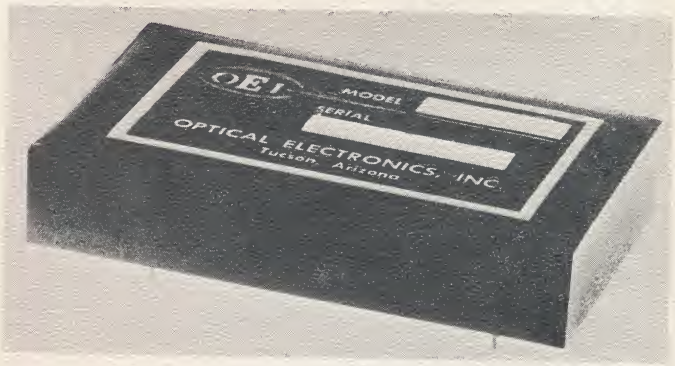
Case 02

OEI Optical Electronics Inc.

P. O. Box 11140 Tucson, Arizona 85706

ANALOG MEMORIES

- PEAK SENSE AND HOLD
- SAMPLE AND HOLD
- 3nS APERTURE TIME (5734)
- 30nS ACQUISITION TIME (5146C)
- 0.3 CUBIC INCH (5204A)



Case 38

MODEL →	5146C	5641	5647	5204B	5734
Memory Type	← PEAK SENSE AND HOLD →			← SAMPLE AND HOLD →	
General Description	HIGH SPEED	LOW COST	GENERAL PURPOSE	LOW COST	VERY FAST
Full Scale Input Voltage	+10V	+10V	+10V	±10V	±1V
Minimum Input Voltage[1]	+0.1V	+0.1V	+0.1V	0	0
Input Impedance	1kΩ	100MΩ	10kΩ	100kΩ	51Ω
Maximum Offset Voltage	30mV	10mV	10mV	10mV	1mV
Voltage Gain	1.0	1.0	1.0	1.0	1.0
Maximum Gain Error	±3.0%	±0.01%	±3.0%	±0.1%	±1.0%
Maximum Memory Decay Rate	30mV/Sec	10mV/Sec	30mV/Sec	30mV/Sec	1V/mS
Reset Command Input	+3 to 10V	+3 to 10V	+3 to 10V	———	———
"Track" Command Input	0	0	0	+3 to 10V	0
Hold Command Input	———	———	———	0	+3V
Command Input Impedance	100kΩ	100kΩ	100kΩ	10kΩ	1kΩ
Maximum Output Voltage	±10V	±10V	±10V	±10V	±1V
Minimum Load Resistance	1000Ω	3000Ω	2000Ω	1000Ω	1000Ω
Output Impedance	1.0Ω	1.0Ω	1.0Ω	1.0Ω	1.0Ω
Frequency Response	3MHz	30Hz	30kHz	1kHz	10MHz
Acquisition Time[2]	30nS	30mS	30µS	300µS	30nS
Aperture Time[2]	———	———	———	3µS	3nS
Reset Time[2]	1µS	300µS	1µS	———	———
Output Temperature Coefficient	±1mV/°C	±30µV/°C	±300µV/°C	±100µV/°C	±100µV/°C
Operating Temperature Range	-25 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +125°C	-25 to +70°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +125°C	-55 to +85°C
Power Supply (Rated) Voltage — Minimum	±10V	±11V	±12V	±5V	±9V
Power Supply (Rated) Voltage — Nominal	±15V	±15V	±15V	±15V	±15V
Power Supply (Rated) Voltage — Maximum	±18V	±18V	±18V	±20V	±18V
Power Supply Current (Quiescent)	±8mA	±7mA	±25mA	±4mA	±25mA
Power Dissipation (Quiescent)	240mW	210mW	750mW	120mW	750mW
Case[3]	38	03	37	23	02
Weight	4 oz	0.6 oz	1.2 oz	0.36 oz	11 oz
Socket - Model	———	11016	———	11016	———
MTBF - per MIL-HDBK-217A	567,000 Hrs	856,000 Hrs	712,000 Hrs	821,000 Hrs	477,000 Hrs

NOTES:
1. Minimum input voltage of the peak sense and hold module is the practical limit determined by the accuracy and offsets.
2. Acquisition time of the peak sense and hold modules is the time required to sense the peak input level. Reset is the time required to return the output to zero. The sample and hold acquisition time is the maximum time to change from hold to sample or track mode with a 20 volt difference. Aperture time is the requirement to change from sample or track to hold mode.
3. Case 02 is 3.0 inches by 2.5 inches by 1.5 inch. Case 03 is 1.0 inch square by 0.5 inch high. Case 23 is 1.0 inch square by 0.31 inch high. Case 37 measures 2.0 inches by 1.0 inch by 0.5 inch. Case 38 measures 3.25 inches by 1.5 inch by 0.625 inch.

OEI Optical Electronics Inc. P. O. Box 11140 Tucson, Arizona 85706

TRANSDUCERS
VOLTAGE-TO-FREQUENCY

- 0.1% TYPICAL LINEARITY
- EXTERNAL SYNCHRONIZATION
- SINUSOIDAL OUTPUT
- TELEMETRY SYSTEMS
- INTEGRATORS
- SWEEP GENERATORS

CASE 03

MODEL[5] →	3329	5329	3370	3374	3375
General Description	±15V Universal	±6V Universal	1kHz Precision	10kHz Precision	100kHz Precision
Output Frequency Range[1]	0-100kHz	0-100kHz	0-1kHz	0-10kHz	0-100kHz
Full Scale Input[2]	+10V	±1mA	+10V	+10V	+10V
Maximum Non-Linearity	±0.3%FS	±1%FS	±0.1%FS	±0.1%FS	±0.1%FS
Practical Dynamic Range	2 decades	2 decades	2.5 decades	2.5 decades	2.5 decades
Input Impedance	10kΩ	30Ω	100MΩ	100MΩ	100MΩ
Sinusoidal Output Level	0.5Vrms	0.5Vrms	7Vrms	7Vrms	7Vrms
Sinusoidal Output Minimum Load	100kΩ	100kΩ	1kΩ	1kΩ	1kΩ
Sinusoidal Distortion - Maximum	10%	10%	5%	5%	5%
Sinusoidal Output Impedance	3000Ω	1800Ω	1.0Ω	1.0Ω	1.0Ω
Triangle Output Level	±5V	±2V	±7.5V	±7.5V	±7.5V
Triangle Output Minimum Load	10kΩ	10kΩ	1kΩ	1kΩ	1kΩ
Triangle Output Impedance	1.0Ω	10Ω	1.0Ω	1.0Ω	1.0Ω
Square Wave Output Level	±10V	±3V	±10V	±10V	±10V
Square Wave Minimum Load	10kΩ	10kΩ	1kΩ	1kΩ	1kΩ
Square Wave Output Impedance	3kΩ	4kΩ	1.0Ω	1.0Ω	1.0Ω
Response Time[3]	10µS	10µS	3.5mS	1.0mS	300µS
Frequency Modulation Bandwidth	30kHz	30kHz	100Hz	300Hz	1.0kHz
Temperature Coefficient	±.03%FS/°C	±.06%FS/°C	±.01%FS/°C	±.01%FS/°C	±.01%FS/°C
Operating Temperature Range	-25 to +75°C	-25 to +75°C	-25 to +75°C	-25 to +75°C	-25 to +75°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Minimum	±3V	±5V	±12V	±12V	±12V
Supply (Rated) Nominal	±15V	±6V	±15V	±15V	±15V
Voltage Maximum	±18V	±8V	±20V	±20V	±20V
Power Supply Current (Quiescent)	±20mA	±10mA	±15mA	±15mA	±15mA
Power Dissipation (Quiescent)	600mW	120mW	450mW	450mW	450mW
Size[4]	03	03	38	38	38
Weight	0.6oz	0.6oz	4oz	4oz	4oz
Socket - Model	11016	11016	——	——	——
MTBF - per MIL-HDBK-217A	802,000Hrs	883,000Hrs	343,000Hrs	343,000Hrs	343,000Hrs

NOTES

1. The exact frequency range of the universal modules is determined by external timing components. A minimum frequency for zero input may be established for the precision modules by an external resistor.
2. One external resistor may be used to change the full scale input voltage of the precision modules to +5V, +3V, +1V, etc.
3. The response time is the time required to change the output frequency with a step function input.
4. Case 03 measures 1.0 inch square by 0.5 inch high. Case 38 is 3.25 inches by 1.5 inches by 0.625 inch.
5. Models 3370, 3374 and 3375 have superceded Models 570A, 5174 and 5175, which are no longer available.

OEI Optical Electronics Inc. (602) 624-8358
P. O. Box 11140 Tucson, Arizona 85706

TRANSDUCERS

FREQUENCY-TO-VOLTAGE

- .03% TYPICAL LINEARITY
- 100mV INPUT SENSITIVITY
- INPUT NOT SENSITIVE TO WAVEFORM
- TELEMETRY SYSTEMS
- FREQUENCY METERS
- FREQUENCY RESPONSE DISPLAYS

CASE 36

MODEL[5] →	3337	5337	3371	3382	3383
General Description	±15V Universal	±6V Universal	1kHz Precision	10kHz Precision	100kHz Precision
Input Frequency Range[1]	0-100kHz	0-100kHz	0-1kHz	0-10kHz	0-100kHz
Full Scale Output[1]	+10V	+3V	+10V	+10V	+10V
Maximum Non-Linearity	±0.3%F.S.	±1%F.S.	±0.03%F.S.	±0.03%F.S.	±0.03%F.S.
Practical Dynamic Range[2]	2 decades	2 decades	2.5 decades	2.5 decades	2.5 decades
Input Impedance	10kΩ	10kΩ	10kΩ	10kΩ	10kΩ
Input Level Minimum[3]	300mVrms	300mVrms	100mVrms	100mVrms	300mVrms
Input Level Maximum	10Vrms	10Vrms	10Vrms	10Vrms	10Vrms
Response Time[1]	35mS	200mS	35mS	3.5mS	3.5mS
Frequency Modulation Bandwidth[1]	10Hz	1.6Hz	10Hz	100Hz	100Hz
Output Ripple and Noise[1]	10mVP-P	2.5VP-P	3mVP-P	3mVP-P	10mVP-P
Output Impedance	1.0Ω	20Ω	1.0Ω	1.0Ω	1.0Ω
Minimum Load Resistance	3kΩ	5kΩ	1kΩ	1kΩ	1kΩ
Temperature Coefficient	±0.03%FS/°C	±0.06%FS/°C	±0.01%FS/°C	±0.01%FS/°C	±0.01%FS/°C
Operating Temperature Range	-25 to +75°C	-25 to +75°C	-25 to +75°C	-25 to +75°C	-25 to +75°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Supply (Rated) Voltage Minimum	±12V	±5V	±12V	±12V	±12V
Power Supply (Rated) Voltage Nominal	±15V	±6V	±15V	±15V	±15V
Power Supply (Rated) Voltage Maximum	±18V	±8V	±20V	±20V	±20V
Power Supply Current (Quiescent	±10mA	±10mA	±22mA	±22mA	±22mA
Power Dissipation (Quiescent)	300mW	120mW	660mW	660mW	660mW
Size[4]	03	03	36	36	36
Weight	0.6 oz	0.6 oz	2 oz	2 oz	2 oz
Socket - Model	11016	11016	—	—	—
MTBF - per MIL-HDBK-217A	1,020,000 Hrs	1,370,000 Hrs	591,000 Hrs	591,000 Hrs	591,000 Hrs

NOTES:

1. Models 3337 and 5337 require external components to determine full scale frequency and voltage, output ripple and noise, bandwidth (response), etc. They may be used within the ranges shown.
2. Practical dynamic range is determined by module linearity and stability and describes the useful range of operation.
3. Minimum input level is determined at the high frequency end. Models 3337 and 5337 use zero crossing detection. Models 3371, 3382 and 3383 use a noise rejection detection circuit at the input.
4. Size 03 measures 1.0 inch square by 0.5 inch high. Size 36 is 2.5 inch by 1.5 inch by 0.5 inch high.
5. Models 3371, 3382 and 3383 have superceded Models 571A, 5182 and 5182, which are no longer available.

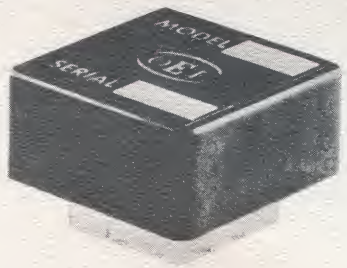
OEI Optical Electronics Inc.

(602) 624 8358

P. O. Box 11140 Tucson, Arizona 85706

ANALOG MULTIPLIERS

- BANDWIDTHS TO 10MHz
- ERRORS TO 0.2%
- LOW COST
- SIZES TO 0.5 INCH^3
- LOW POWER



CASE STYLE 03

In addition to the models listed here, see data sheets on our TO-5 Monolithic Multipliers - Models 5500 and 5507.

MODEL →	5109C	5323A	5485	5759	5805
General Description	WIDE BAND	PRECISION	LOW COST	LOWEST COST	WIDE BAND
TRANSFER Equation[1] $e_o =$	XY/10	XY/10	XY/10	XY/10	XY/10
Maximum Static Error[2]	±1.0%FS	±0.2%FS	±1.0%FS	±3.0%FS	±3.0%FS
Maximum Dynamic Error[3]	±1.0%FS	±0.1%FS	±1.0%FS	±3.0%FS	±3.0%FS
Maximum X=0, Y=0 Error[4]	±1.0%FS	±0.05%FS	±0.1%FS	±1.0%FS	±1.0%FS
Maximum X=±10, Y=0 Error[5]	±1.0%fs	±0.1%FS	±0.2%FS	±1.0%FS	±1.0%FS
Maximum X=0, Y=±10 Error[5]	±1.0%FS	±0.1%FS	±0.2%FS	±1.0%FS	±1.0%FS
Input Impedance	X=10,Y=100 kΩ	100kΩ	100kΩ	X=100kΩ,Y=2MΩ	10kΩ
Full Scale, Both Inputs	±10V	±10V	±10V	±10V	±10V
Maximum Voltage at Inputs	±25V	±25V	±25V	±25V	±25V
Full Scale Output	±10V	±10V	±10V	±10V	±10V
Dynamic Output Impedance	10Ω	1.0Ω	1.0Ω	1.0Ω	1kΩ
Minimum Load Resistance	3kΩ	1kΩ	1kΩ	1kΩ	3kΩ
Frequency[6] Response Lower	DC	DC	DC	DC	DC
Frequency[6] Response Upper	3MHz	3kHz	30kHz	3kHz	1MHz
Output Temperature Coefficient[7]	±0.1%FS/°C	±0.01%FS/°C	±0.1%FS/°C	±0.3%FS/°C	±0.3%FS/°C
Operating Temperature Range	-55 to +65°C	-25 to +85°C	-55 to +70°C	-25 to +75°C	-25 to +75°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Required Voltage	±15V	±15V	±15V	±15V	±15V
Power Required Current	±40mA	±12mA	±8mA	±3mA	±35mA
Case[8]	02	38	03	03	03
Weight	11 oz	4 oz	0.6 oz	0.6 oz	0.6 oz
Socket - Model	——	——	11016	11016	11016
MTBF - Calculated	80,400 Hrs	388,000 Hrs	537,000 Hrs	1,186,000 Hrs	1,320,000 Hrs
External Adjustments[9]	K,I,OE	IE,OE	IE,OE,KE	IE,OE,K	IE,OE,K
Connectors[10]	S	P	P	P	P

NOTES:

1. The constant term in the equation may be altered externally for all models except 5323A, which has a ±10% tolerance on this parameter.
2. Static Error is a function of the output zero level which is externally adjustable on all models. This is also referred to as Linearity.
3. Dynamic Error is measured at 300Hz for the 5323A, 3kHz for the 5759, 10kHz for the 5485, 500kHz for the 519, 5109C and 5805.
4. This error is strictly a function of the output zero level, externally determined.
5. These error figures may be reduced on all models except 519 and 5109C.
6. Frequency response indicates the bandwidth of full output, useful performance. This is not a figure of -3dB bandwidth which is 3 to 10 times higher.
7. Output Temperature Coefficient describes the combined effect of offset and gain changes due to temperature.
8. Case 02 measures 3.0 inches by 2.5 inches by 1.5 inch. Case 03 measures 1.0 inch square by 0.5 inch. Case 38 measures 3.25 inches by 1.5 inch by 0.625 inch.
9. IE indicates input offset adjustment by an external resistor. I indicates a potentiometer input offset adjustment. OE indicates output zero level externally adjustable with a resistor. K means the gain is adjustable with a potentiometer on the module.
10. P indicates solder or socket pins are used for electrical connections. BI indicates a BNC is used for the input. BO means a BNC connector is used for the output.

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ANALOG

MULTIPLIERS / DIVIDERS

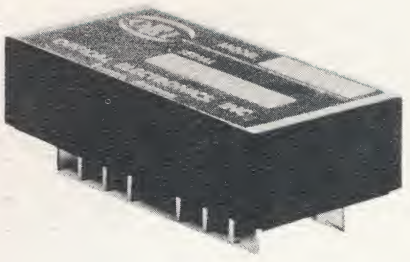
- DIVIDE
- MULTIPLY
- SQUARE
- SQUARE-ROOT
- FREQUENCY DOUBLE
- HYPERBOLAS
- MEAN SQUARE
- RATIOS

CASE STYLE 03

MODEL →	5120A	5191B	5196A	5391	5627
General Description	LOW-COST DIVIDER	WIDE-BAND DIVIDER	4-QUADRANT DIVIDER	MULTIPLIER-DIVIDER	LOW-COST MULT./DIV.
Multiplier Transfer Equation e_o=	X/10Y	X/Y	10X/Y	XY/10 10X/Y	XY/10, 10X/Y
Maximum Static Error[1]	±1.0%FS	±1.0%FS	±1.0%FS	±1.0%FS	±3.0%FS
Maximum Dynamic Error[2]	±3.0%FS	±3.0%FS	±3.0%FS	±3.0%FS	±3.0%FS
Maximum Zero Product Error	—	—	—	0.3%FS	1.0%FS
Input Impedance, Both Inputs[3]	1000Ω	10kΩ	10kΩ	10kΩ	100kΩ
Full Scale, Both Inputs[3]	±1.0V	±10V	±10V	±10V	±10V
Maximum Voltage at Input	±25V	±25V	±15V	±25V	±25V
Full Scale, Output[3]	±1.0V	±10V	±10V	±10V	±10V
Minimum Load Resistance	1000Ω	5000Ω	1000Ω	10kΩ	1000Ω
Dynamic Output Impedance	1.0Ω	10Ω	10Ω	1.0Ω	1.0Ω
Multiplier small signal bandwidth	—	—	—	300kHz	100kHz
Multiplier large signal bandwidth	—	—	—	100kHz	10kHz
Utility Amplifier small signal bandwidth	—	—	—	100kHz	100kHz
Utility Amplifier large signal bandwidth	—	—	—	10kHz	10kHz
Multiplier Roll-off rate	—	—	—	6dB/oct	6dB/oct
Utility Amplifier Roll-off rate	—	—	—	6dB/oct	6dB/oct
Output Temperature Coefficient	±0.1%FS/°C	±0.1%FS/°C	±0.1%FS/°C	±0.1%FS/°C	±0.3%FS/°C
Operating Temperature Range	0 to +85°C	0 to +65°C	0 to +50°C	-55 to +70°C	-55 to +70°C
Storage Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Power Required Voltage	±15V	±15V	±15V	±15V	±15V
Power Required Current	±5mA	±40mA	±40mA	±12mA	±15mA
Case[4]	03	02	02	02	37
Weight	0.6oz	11oz	11oz	11oz	1.2oz
MTBF - Calculated	1,627,000Hrs	156,000Hrs	256,000Hrs	326,000Hrs	376,000Hrs
Connectors	P	S	S	S	P

NOTES:

1. Static error is actually linearity plus offser errors combined.
2. Dynamic error is measured at 10kHz for Models 5391 and 5627, at 100kHz for Models 5120A and 5191B and at 300kHz for 5196A.
3. These specifications pertain to both the multiplier and the utility amplifier sections.
4. Case 02 measures 3.0 inch by 2.5 inch by 1.5 inch. Case 03 measures 1.0 inch square by 0.5 inch high. Case 37 measures 2.0 inch by 1.0 inch by 0.5 inch high.
5. S signifies a threaded stud used to fasten a solderless crimp-type or solder lug. P indicates solder pins.



CASE STYLE 37

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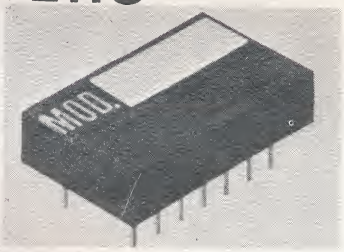
Hybrid
ANALOG/DIGITAL CONVERTERS

- 7400: 7 Bit binary to analog converter complete. For use with COSMOS 4004 type ripple counter.
- 7401: Converts 7402 output into analog information - useful in data links, memories, etc.
- 7402: Delta modulator for analog to series digital - "1 - bit" converter applications in A→D,
- 7404: 8 Bit BCD to analog converter complete. For use with COSMOS type decade counters.



Case 45

Model →	7400	7401	7402	7404
General Description	7 Bit Parallel Binary Digital to Analog Converter	Serial Digital to Analog Converter	Delta Modulator A→D Converter	8 Bit Parallel BCD Digital to Converter
Digital Input[1] Logic "1"	+5V	+3V to +10V	——	+5V
Digital Input[1] Logic "0"	-5V	-3V to -10V	——	-5V
Analog Input	——	——	±1V .FS.	——
Input Impedance	50kΩMSB	10kΩ	3MΩ	20kΩMSB
Conversion Error[2]	5 bits	<0.3%	<2%	5 bits
Conversion Resolution	7 bits	infnite	infinite	8 bits
Bit Error[2]	±5%	——	——	±5%
Output Offset Voltage[3]	±10mV	±30mV	——	±10mV
Output Voltage Swing[4]	±10V	±0.5V	±10V	±10V
into load resistance of	1000Ω	50Ω	1000Ω	1000Ω
Output Impedance	1.0Ω	1.0Ω	100Ω	1.0Ω
Clock Rate[5] Minimum	——	0	0	——
Clock Rate[5] Maximum	——	300kHz	300kHz	——
Internal Clock Rate	——	——	30kHz	——
Output Slew Rate[6]	±0.3V/µS	±0.3V/µS	20V/µS	±0.3V/µS
Settling time to 1.0%[6]	33µS	3µS	3µS	33µS
Conversion time	35µS	4µS	3µS	35µS
Response time	1µS	1µS	——	1µS
Output Temperature Coefficient	±100µV/°C	±100µV/°C	——	±100µV/°C
Operating Temperature Range	-55 to +85°C	-55 to +85°C	-55 to +85°C	-55 to +85°C
Storage Temperature Range	-55 to +100°C	-55 to +100°C	-55 to +100°C	-55 to +100°C
Power Supply Voltage Minimum	±4V	±4V	±4V	±4V
Power Supply Voltage Nominal-Rated	±15V	±15V	±15V	±15V
Power Supply Voltage Maximum	±20V	±20V	±20V	±20V
Quiescent Supply Current	±2mA	±4mA	±6mA	±2mA
Quiescent Power Dissipation	60mW	120mW	180mW	60mW
Case[7]	45	45	45	45
Weight	0.09 oz	0.09 oz	0.09 oz	0.09 oz
Socket	8	8	8	8
MTBF-per MIL-HDBK-217A	2,281,000 Hrs	976,000 Hrs	940,000 Hrs	2,256,000 Hrs

NOTES:

1. The 7400 and 7404 is rated for 5 volt input levels, however other levels may be used as long as they are symmetrical about zero. The output analog level will change in proportion to the input levels.
2. Each bit in the 7400 and 7404 may be in error by 5%, typically 2%, thus limiting the useful conversion accuracy to 5 bits.
3. The 7401 output offset voltage is based on an input duty cycle of 50.0%.
4. Output swing of the 7401 cannot be increased externally and is independent of input level. It is based on input duty cycle (pulse width) modulation.
5. The 7402 clock rate is externally adjustable and synchronizable. The internal clock is also available for driving other circuits.
6. The output slew rate limits the settling time figures for the 7400 and 7401. Slew rate limits the useful upper 7402 clock rate.
7. Case 45 is a 14 pin dual in-line hybrid package measuring 0.8 inch by 0.5 inch by 0.2 inch.
8. These modules plug into any standard 14 pin dual in-line socket.

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PRICE LIST

MODEL	PRICE 1-2	PRICE 3-9	PRICE 10-29
2245C	$185.00	$165.00	$149.00
2255A	77.00	69.00	62.00
2357	57.00	52.00	47.00
2421	35.00	32.00	29.00
2457	125.00	113.00	102.00
2507	71.00	64.00	58.00
2519	145.00	132.00	118.00
2523	44.00	40.00	36.00
2531	215.00	191.00	172.00
2532	71.00	64.00	58.00
376	57.00	52.00	47.00
395	93.00	84.00	76.00
3329	79.00	72.00	65.00
3337	65.00	59.00	54.00
3370	170.00	150.00	135.00
3371	150.00	135.00	122.00
3374	225.00	202.00	182.00
3375	225.00	202.00	182.00
3382	150.00	135.00	122.00
3383	150.00	135.00	122.00
5109C	280.00	252.00	227.00
5120A	57.00	52.00	47.00
5146C	120.00	109.00	98.00
5191B	215.00	194.00	175.00
5196A	245.00	221.00	199.00
5204B	86.00	77.00	69.00
5217A	60.00	54.00	49.00
5249A	265.00	239.00	215.00
5323A	105.00	95.00	86.00
5329	75.00	68.00	62.00
5337	65.00	59.00	54.00
5391	165.00	149.00	134.00
5485	79.00	71.00	64.00
5627	130.00	117.00	106.00
5641	70.00	63.00	57.00
5647	87.00	78.00	70.00
5712	240.00	216.00	195.00
5734	215.00	194.00	175.00
5748	200.00	180.00	162.00
5759	46.00	42.00	38.00
5762	230.00	207.00	187.00
5805	63.00	57.00	52.00
627A	1495.00	1495.00	1346.00
7400	48.00	43.00	39.00
7401	66.00	59.00	53.00
7402	55.00	50.00	45.00
7404	49.00	44.00	40.00

MODEL	PRICE 1-2	PRICE 3-9	PRICE 10-29
885	$ 48.00	$ 48.00	$ 46.00
887	27.00	27.00	26.00
888	33.00	33.00	32.00
892	63.00	63.00	60.00
976A	43.00	39.00	35.00
9110B	41.00	37.00	33.00
9146B	37.00	33.00	30.00
9162A	50.00	45.00	41.00
9186B	63.00	57.00	51.00
9245A	61.00	55.00	50.00
9251	42.00	38.00	34.00
9278A	55.00	50.00	45.00
9406	29.00	26.00	23.00
9412	49.00	44.00	40.00
9428	66.00	59.00	53.00
9432	74.00	67.00	60.00
9487	77.00	69.00	62.00
9491	150.00	135.00	122.00
9510	35.00	32.00	29.00
9524	68.00	61.00	55.00
9682	56.00	51.00	46.00
9684	63.00	57.00	52.00
9685	71.00	64.00	58.00
9686	97.00	88.00	80.00
9687	145.00	131.00	118.00
9688	96.00	87.00	79.00
9689	64.00	58.00	53.00
9690	93.00	84.00	76.00
9691	135.00	122.00	110.00
9692	130.00	118.00	107.00
9693	55.00	50.00	45.00
9694	57.00	52.00	47.00
9695	98.00	88.00	79.00
9696	135.00	122.00	110.00
9697	82.00	74.00	67.00
9698	62.00	56.00	51.00
9699	120.00	108.00	98.00
9706	54.00	49.00	45.00
9708	49.00	44.00	40.00
9709	73.00	66.00	59.00
9710	94.00	85.00	77.00
9711	88.00	80.00	72.00
9712	62.00	56.00	51.00
9728	72.00	65.00	59.00
9776	58.00	53.00	48.00
9800	50.00	45.00	41.00
11016	8.00	8.00	7.50
11020	8.00	8.00	7.50
11025	18.00	18.00	18.00

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NOTES:

1. These prices are effective August 1, 1970. All other price lists are void.
2. Prices are subject to change without notice.
3. Terms are Net 30 days. FOB, Tucson. 1% per month will be charged for all past due invoices.
4. All items listed are normally in stock and shipped within one day from receipt of order. Shipments of less than $800 are via Air Parcel Post. Over $800 shipments are via Air Express, unless otherwise instructed. OEI will always declare maximum value unless otherwise instructed.
5. Minimum Order is $15.00.
6. Extra Instruction Manuals are $0.50 each for all Models except 627A, which is $5.00 each. Minimum order is waived for Instruction Manual and Application Book orders.
7. For quantities of 30 or more, consult OEI for price and delivery information.
8. All products are warranted for one year against materials and workmanship except for Incadescent lamps which are warranted for 90 days. See OEI Warranty. The original Warranty applies to replacements.
9. A cancellation charge of 15% will be made for all models and prior to production of non-standard items. A 40% charge will be made after production of non-standard items.
10. A charge of 15% will be made for re-testing of returned merchandise that has been found to meet all published specifications.
11. Any modification of an existing model will result in a 40% increase in price.

DOMESTIC REPRESENTATIVES

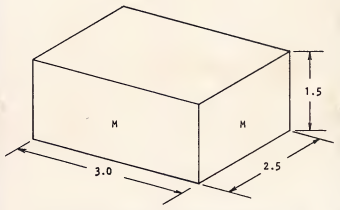
ALABAMA	OEI	602-624-8358
ALASKA	OEI	602-624-8358
ARIZONA	OEM SPECIALTIES	602-946-4617
ARKANSAS	APPLIED SCIENCE ASSOC.	214-352-4829
CALIF/NORTHERN	OEI	602-624-8358
CALIF/SOUTHERN	CDH ASSOC	213-345-1644
COLORADO	OEI	602-624-8358
CONNECTICUT	OEI	602-624-8358
DELAWARE	JOHN HOPKINS ASSOC.	703-280-2086
FLORIDA	WMM ASSOC	813-446-0075
FLORIDA	WMM ASSOC	305-934-3091
FLORIDA	WMM ASSOC	305-831-4645
GEORGIA	JOHN HOPKINS ASSOC.	703-280-2086
HAWAII	ALOHA ASSOC	808-923-5839
IDAHO	OEI	602-624-8358
ILLINOIS	S. STERLING CO	312-298-4830
INDIANA	S. STERLING CO	317-251-5508
IOWA	S. STERLING CO	312-298-4830
KANSAS	OEI	602-624-8358
KENTUCKY	OEI	602-624-8358
LOUISIANA/NORTHERN	APPLIED SCIENCE ASSOC.	214-352-4829
LOUISANA/SOUTHERN	OEI	602-624-8358
MAINE	OEI	602-624-8358
MARYLAND	JOHN HOPKINS ASSOC.	703-280-2086
MASSACHUSETTS	OEI	602-624-8358
MICHIGAN	OEI	602-624-8358
MINNESOTA	S. STERLING CO	312-298-4830
MISSISSIPPI	OEI	602-264-8358
MISSOURI	OEI	602-624-8358
MONTANA	OEI	602-624-8358
NEBRASKA	OEI	602-624-8358
NEVADA	OEI	602-624-8358
NEW HAMPSHIRE	OEI	602-624-8358
NEW JERSEY/NORTHERN	J.J.ASSOC	201-233-4562
NEW JERSEY/SOUTHERN	BACH-STEWART ASSOC.	215-927-1200
NEW MEXICO	OEI	602-624-8358
NEW YORK/UP STATE	RJC ASSOC	607-753-3909
NEW YORK CITY	J.J.ASSOC	201-233-4562
NORTH CAROLINA	OEI	602-624-8358
NORTH DAKOTA	OEI	602-624-8358
OHIO	OEI	602-624-8358
OKLAHOMA	APPLIED SCIENCE ASSOC.	214-352-4829
OREGON	PARATECH	206-784-6447
PENNSYLVANIA/EASTERN	BACH-STEWART ASSOC.	215-927-1200
PENNSYLVANIA/WESTERN	OEI	602-624-8358
RHODE ISLAND	OEI	602-624-8358
SOUTH CAROLINA	OEI	602-624-8358
SOUTH DAKOTA	OEI	602-624-8358
TENNESSEE	OEI	602-624-8358
TEXAS/EASTERN	APPLIED SCIENCE ASSOC.	713-781-1441
TEXAS/N WESTERN	APPLIED SCIENCE ASSOC.	214-352-4829
UTAH	OEI	602-624-8358
VERMONT	OEI	602-624-8358
VIRGINIA	JOHN HOPKINS ASSOC.	703-280-2086
WASHINGTON	PARATECH	206-784-6447
WASHINGTON D.C.	JOHN HOPKINS ASSOC.	703-280-2086
WEST VIRGINIA	JOHN HOPKINS ASSOC.	703-280-2086
WISCONSIN	S. STERLING CO	312-298-4830
WYOMING	OEI	602-624-8358
CANADA	ELECTRODESIGN LTD.	514-363-5120
CANADA	ELECTRODESIGN LTD.	416-787-0991

FOREIGN REPRESENTATIVES

FRANCE	SOCIETE ELECTRONIQUE	ROQ.82-95et91-64
HOLLAND	MULDER-HARDENBERG AMSTERDAM Z.	(020) 76 10 02
ITALY	COMPAGNIA DI REGOLAZIONI AUTOMATICHE S.R.L.	.688.1578
JAPAN	MARUBUN CO.,LTD.	(03)662-8151
SWEDEN	AMERICKASKA TELEPRODUKTER AB	7109950.7109960
SWITZERLAND	ELEKTRONIK UND MESSTECHNIK	051-483-007/480244
AUSTRALIA	A. J. FERGUSON (ADELAIDE) PTY.LTD.	23 1922 (3 lines)

OUTLINES

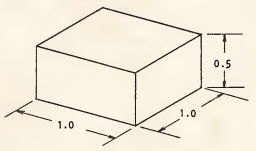
CASE 02



M - Mounting surface in addition to the underneath terminal surface. Mounting uses 6-32 hardware. Terminals are 6-32 studs and/or BNC type connectors.

180 001

CASE 03



Module uses OEI Model 11016 Socket. Underneath surface has 0.031 inch diameter, gold plated pins on 0.2 inch center-to-center spacing. Socket or soldered printed circuit board mounting.

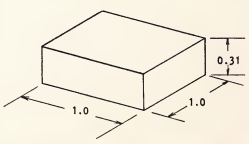
Pin configuration varies with different models.

Case material is Glass fiber filled Diallyl-Phthalate.

180 002

CASE 23

Case material is Glass fiber filled Diallyl-Phthalate.



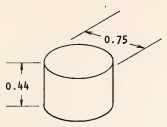
Module uses OEI Model 11016 Socket. Underneath surface has 0.031 inch diameter, gold plated pins on 0.2 inch center-to-center spacing. Socket or soldered printed circuit board mounting.

Pin configuration varies with different models.

180 004

CASE 29

Module uses OEI Model 11020 Socket. Underneath surface has 0.040 inch diameter, electro-tin plated pins on 0.1 inch center spacing.

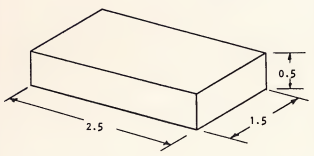


Module is Socket or soldered printed circuit board mounted.

Case material is Glass fiber filled Diallyl-Phthalate

180 005

CASE 36

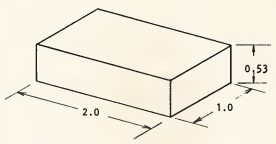


Module is mounted by soldering on a printed circuit board. Underneath surface has 0.040 inch diameter, gold plated pins.

Case material is Glass Fiber filled Diallye-Phthalate.

180 016

CASE 37



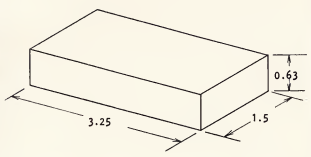
Module may be plugged into a standard 0.6 inch jumbo dual in-line socket or soldered on a printed circuit board.

Underneath surface has 0.040 inch diameter pins on 0.2 inch center-to-center spacing, 2 - 0.6 inch spaced rows.

Case material is Glass fiber filled Diallyl-Phthalate.

180 006

CASE 38

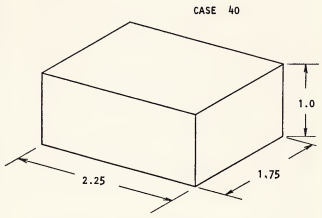


Module is mounted be soldering on a printed circuit board. Underneath surface has 0.040 inch diameter, gold plated pins.

Case material is Glass fiber filled Diallyl-Phthalate.

180 007

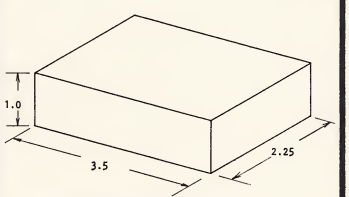
CASE 40



Module may be mounted by 4-40 hardware. The underneath surface has 0.040 inch diameter pins.

180 008

CASE 41

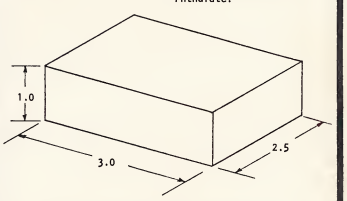


Module may be mounted with 4-40 hardware. The underneath surface has 0.040 inch diameter pins.

180 009

CASE 44

Case material is Glass Fiber filled Diallyl-Phthalate.

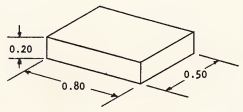


Module may be mounted by 6-32 hardware and/or soldered on a printed circuit board. Underneath surface has 0.040 inch diameter, gold plated pins. Number varies with model.

180 014

CASE 45

Case material is Glass Fiber filled Diallyl-phthalate.

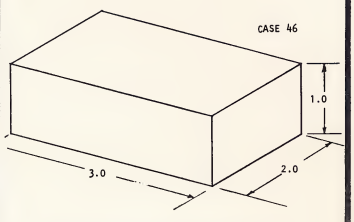


Module has 14 flat pins located on 0.1 inch center locations in two rows of seven. The rows are 0.3 inch apart.

Module may be plugged into standard 14 pin dual inline socket or soldered on a printed circuit board.

180 013

CASE 46



Module may be mounted by 4-40 Hardware. The underneath surface has 0.040 inch diameter pins.

180 015

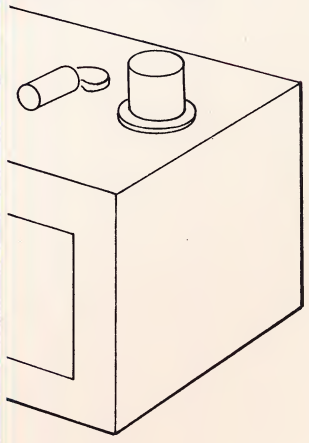
OEI

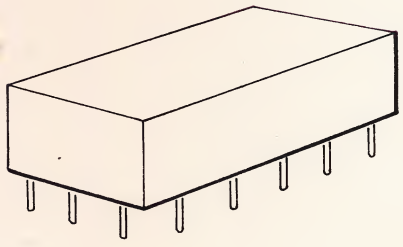
- **Amplifiers**

operational
logarithmic

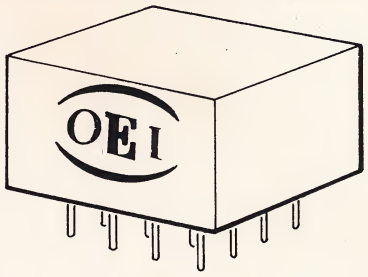
- **Function Modules**

multipliers
dividers
squarers
square-rooters
peak sense & hold
sample sense & hold
voltage-frequency
frequency-voltage





- **Three Dimensional Displays**



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Outstanding